

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR NORTHERN COLLECTOR TUNNEL PHASE 1



FINAL STUDY REPORT

ATHI WATER SERVICES BOARD (AWSB)

I certify that this Environmental and Social Impact Assessment (ESIA) Study Report for the proposed Northern Collector Tunnel Phase 1 was conducted under my direction.

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GIBB AFRICA CERTIFICATION

I certify that this Environmental and Social Impact Assessment (ESIA) Study for the proposed Northern Collector Tunnel Phase 1 was conducted under my direction and that I have reviewed and approved the report.

I hereby certify that the particulars given in this report are correct and true to the best of my knowledge.

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ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT STUDY REPORT

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LIST OF ACRONYMS

| | |
|--------|--|
| ACC | Assistant County Commissioner |
| AFD | Agence Française de Développement |
| AIDS | Acquired Immunodeficiency Syndrome |
| AWSB | Athi Water Services Board |
| BS | British Standards |
| CSR | Corporate Social Responsibility |
| DCC | Deputy County Commissioner |
| DOSH | Directorate of Occupational Safety and Health |
| EIA | Environmental Impact Assessment |
| EMCA | Environmental Management & Coordination Act |
| ESIA | Environmental & Social Impact Assessment |
| ha | Hectare |
| HEP | Hydro Electric Power |
| HIV | Human Immunodeficiency Virus |
| ITCZ | Inter Tropical Convergence Zone |
| KFS | Kenya Forest Service |
| Km | Kilometre |
| KTDA | Kenya Tea Development Authority |
| KWS | Kenya Wildlife Service |
| LH | Lower Highlands |
| m | Metre |
| Ma | Miocene Age |
| maod | Metres Above Ordnance Datum |
| MCA | Member of County Assembly |
| MDGs | Millennium Development Goals |
| mm | Milimetre |
| NCT1 | Nothern Collector Tunnel Phase 1 |
| NEMA | National Environment Management Authority |
| NGO | Non-governmental organisation |
| NWL | Normal Water Level |
| OP | Operational Policy |
| OSHA | Occupational Safety and Health Act |
| PPE | Personal Protective Equipment |
| Q | River discharge (m ³ /s) |
| Qc | Minimum compensation flow |
| Qd | Diverted flow/intake diversion capacity |
| RAP | Resettlement Action Plan |
| RGS | River Gauging Station |
| SAF | St. Anthony Falls stilling basin |
| STI | Sexually Transmitted Infection |
| TB | Tuberculosis |
| TBM | Tunnel Boring Machine |
| UH | Upper Highland |
| UM | Upper Midland |
| URTI | Upper Respiratory Tract Infections |
| USBR | United States Bureau of Reclamation stilling basin |
| USD | United States Dollar |
| VCT | Voluntary Counselling and Testing |
| VIP | Ventilated Improved Pit Latrines |
| WASREB | Water Services Regulatory Board |
| WaSSIP | Water and Sanitation Services Improvement Project |
| WB | World Bank |
| WRMA | Water Resource Management Authority |
| WRUA | Water Resource Users Association |
| WSPs | Water Services Providers |
| WSTF | Water Services Trust Fund |

EXECUTIVE SUMMARY

E1 Project background and components

Athi Water Services Board (AWSB) has commissioned GIBB Africa Ltd to prepare an Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, a Raw Water Pipeline, and Treated Water Pipeline to Kabete Reservoir.

Following screening and scoping at initial stages, an ESIA Project Report was prepared and submitted to the National Environment Management Authority (NEMA) for review (NEMA Ref: NEMA/PR/5/2/12495). Following the review NEMA recommended wider public consultations and in-depth coverage of the foreseen impacts and proposed mitigation measures. ESIA study TOR were prepared and approved by NEMA in July 2014. This ESIA Study Report covers the ESIA for Northern Collector Tunnel (NCT) Phase 1.

The NCT Phase 1 Project is located in Kangema and Kigumo Sub-Counties of Muranga County. The project is located along the eastern fringe of the Aberdare Conservation Area approximately 60 km north of Nairobi.

The NCT Phase 1 Project consists of a tunnel which will transfer raw water through approximately 11.8 km from intakes at the Maragua, Gikigie and Irati Rivers to an outlet at the Githika River near Makomboki, upstream of the existing Thika Reservoir into which the water will be transferred. The design life of the main tunnel and its associated permanent infrastructure elements will be of 100 years. The principal features of the NCT Phase 1 include the following:

- River diversion weir and related intake hydraulic structures at Maragua River including:
 - 20 m wide, 5 m high weir including trench diversion intake
 - 37 m long, 4 m deep de-silting basin
 - Compensation channel
- River diversion weir and related intake hydraulic structures at Gikigie River including:
 - 14 m wide, 3.3 m high weir including trench diversion intake
 - 17 m long, 2 m deep de-silting basin
 - Compensation channel
- River diversion weir and related intake hydraulic structures at Irati River including:
 - 20 m wide, 4.4 m high weir including trench diversion intake
 - 25 m long, 2 m deep de-silting basin
 - Compensation channel
- Drop shaft and connection gallery connecting the Irati intake to the main tunnel
- River outlet at Githika River including:
 - Cut and cover portal outlet from the main tunnel
 - 20 m long outfall stilling basin structure
- Main Northern Collector Tunnel Phase 1 (main tunnel) including portals, excavation, initial support and permanent concrete lining. The tunnel is approximately 11.8 km long and of 3 m finished internal diameter:
 - Connection adit from Githika tunnel to the main tunnel;
 - Drop Shaft and connection adit at the Irati intake;
 - Access gallery from Kaanja Valley to the main tunnel.

The diversion and intake structures on rivers Maragua, Gikigie and Irati will divert $3\text{m}^3/\text{s}$, $1\text{m}^3/\text{s}$ and $2\text{m}^3/\text{s}$ respectively to the collector tunnel. The weirs and intakes are designed to harness flood flows and allow for compensation flows equivalent to Q95 flows for both Maragua (Q95= $0.481\text{m}^3/\text{sec}$) and Gikigie (Q95 = $0.101\text{m}^3/\text{sec}$) rivers. In the case of the Irati River the estimated compensation flow used is $1.4\times\text{Q95}$ ($0.645\text{m}^3/\text{sec}$) since Q95 flows alone was deemed inadequate.

The operational requirement of the compensation channel is considered in three phases as follows:

- At low river flows, i.e. not exceeding the required minimum compensation flow $Q < Q_c$, the compensation channel gate is fully open and all flows are permitted through the compensation channel gate under free flow condition. The low flows are not permitted through the diversion intake until the required minimum compensation flow is satisfied;
- At higher river flows, i.e. exceeding required minimum compensation flows but excess not exceeding intake diversion capacity ($Q > Q_c$ and $Q - Q_c < Q_d$), the compensation channel gate is partially open to only permit the minimum compensation flow (Q_c) and divert the excess ($Q - Q_c$) to the tunnel intake. The head of water behind the compensation gate contribute to pressure flow through the gate orifice; and
- At river flows exceeding the required minimum compensation plus maximum diversion flows (i.e. $Q > Q_c + Q_d$), the compensation channel gate is fully closed. The excess of diverted flow (i.e. $Q - Q_d$) is passed to the downstream through the main overflow weir, and exceeds the required minimum compensation flow.

The project implementation period is estimated to take about 40 months and on completion will deliver on average 120,000 m³/d to existing Thika dam.

E2 Existing Environment

Ecological survey conducted on the rivers established a total of 77 species of aquatic fauna including 7 fish species. The fishes include Stargazer mountain catfish (*Amphilius uranoscopus*), Pangani Barb fish (*Barbus oxyrhynchus*), Barb fish (*Barbus sp*), *Barbus paludinosus*, Red eye Labeo fish (*Labeo cylindricus*), Athi tilapia (*Oreochromis spirulus*) and Dembea stone lapper (*Garra dembensis*). In addition, some species were not encountered during the study but secondary sources and local knowledge confirmed their presence. These include *Anguilla bengalensis labiata*, Rainbow trout (*Oncorhynchus mykiss*), Salmon (*Salmo gaidneri*) and salmon (*Salmo trutta*). Of particular interest are the *Labeo cylindricus*, *Barbus sp* and the eel *Anguilla* which are migratory species. The *Labeo cylindricus* and *Barbus sp* were recorded at lower river Maragua upwards of the Wanjii Reservoir but were not recorded at the confluence of river Maragua and Sagana although it is known to occur in the middle stream reaches of R. Tana. *Labeo cylindricus* migrate upstream of rivers to spawn and uses the mouth and pectoral fins to climb barrier rocks and weirs. None of the aquatic species recorded is listed in the IUCN Red-list or the Sixth Schedule (Part D) of the Kenya Wildlife Act, 2003 both of which list threatened species.

Natural vegetation in the project area has been significantly modified by settlements and the small holder tea farms. A botanical survey conducted on the reaches of NCT 1 rivers established 279 plant species within the sample points. Of these, 6 species were found to be of special conservation concern. These include *Polyscias kikuyensis*, *Polystachya sp*, *Aerangis thomsonii*, *Prunus africana*, *Rubus keniensis* and *Rubus steudneri*.

There is no gazetted conservation area within the immediate project area. However, the Aberdare Conservation Area (Aberdare National Park and forest reserve) is about five kilometres upstream of the proposed intakes and is the catchment for the Project Rivers. The project is not likely to have impacts on the forest but the project's sustainability will depend on continued conservation of the forest.

E3 Feedback from consultation

During the ESIA study consultations were held through: (1) six (6) general public meetings at location levels within the project area; (2) key informant interviews with civil, government agencies and other institutions in the project area, from both Kigumo and Kangema sub counties as well as with various bulk water service providers; (3) household surveys; and (4) a stakeholders' workshop on 2 October 2014 at Norkas hotel in Murang'a town to disclose findings of ESIA studies. In the workshop, stakeholders' representation was from the local to the national levels and included international financing agencies. A summary of expected benefits and expressed concerns are given below.

i. The Expected benefits include:

- Employment opportunities: community members requested that the proposed project should alleviate unemployment issues by absorbing bulk of the youth in the local area to work in its construction and operation stages;
- Increased sale in crop production especially food products from farmers in Kigumo and Kangema Sub County;
- Increased activities related to trading due to availability of markets;
- Increased reliable water supply in the south of Muranga. Proposed kick-back water supply projects to Muranga; and
- Additional water to Thika Dam thus boosting water supply to Nairobi City (be of great value to the growing demand in the areas).

ii. Expected negative impacts include:

- Vibrations due to underground work activities during construction;
- Reduced river flow/ volumes down stream in Maragua, Gikigie and Irati Rivers;
- Intake structure preventing migratory fish upstream;
- Damage to roads during construction due to heavy equipment;
- Rise in cases of accidents and incidents during construction;
- Community health and increase in disease prevalence and unwanted teenage pregnancies;
- Fear of the possible impact on landslides and earth movements;
- Displacement of farmers paving way for the wayleave for the Tunnel;
- Interruption of school activities: Concerns were raised over the fact that construction might interrupt schooling and education activities in the area;
- Lack of Health Facilities: FDGs raised concerns over the number of health facilities in the area, noting that in some areas far from town centres, women have to travel long distances up- hill to access health care facilities, especially maternity services; and
- Vibrations due to underground work activities during construction.

Through the disclosure workshop, concerns expressed by the participants were addressed by both the consultant and AWSB.

The views of those affected by or interested in the project were also used to inform identification and evaluation of both social and environmental impacts and have been considered in the formulation of mitigation measures and formulation of the environment management plan.

E4 Assessment of Project Impacts

The project will have both positive and negative impacts.

iii. Positive Impacts

The positive impacts include the following:

Improved water supply: Nairobi is experiencing a water crisis with the current demand (750,000m³/day) far much outstripping supply (540, 000m³/day). Most Nairobi residents are therefore accustomed to water rationing. The proposed project will therefore ensure adequate water provision to Nairobi residents and its satellite towns.

Communities in Murang'a County will also benefit through improved waters supply schemes supported by AWSB as part of giving back to the community from where it is drawing its water supplies. AWSB has developed a strategy to complement the efforts of Tana Water Services Board (TWSB) in provision of water to these communities. This will see the Murang'a

communities benefit from development of water projects to the tune of Ksh. 1.270 billion. The key projects to be developed under this arrangement include:

- Muranga W/S (augmentation) – KSh. 800 Million;
- Gatanga W/S (augmentation) - KSh. 300 Million; and
- Gatango W/S (augmentation) – KSh. 170 Million.

Creation of employment opportunities: The construction of the project is anticipated to create numerous direct and indirect employment and economic opportunities through recruitment of significant numbers of people to work with the contractor (s). This will include both skilled and unskilled labour that will be engaged for about 40 months. Man hours to be provided by non technical staff alone have been estimated at 4,100 hours. Indirect economic opportunities will also be created through persons selling different wares to the construction staff domestic requirements. Limited staff will also be required for routine O&M. These will improve economic situation in the project area and partly reduce unemployment levels.

Improved infrastructure: The NCT Phase 1 project design has proposed improvement of access roads within the proposed project area. This will be an advantage to the locals as they will comfortably transport their tea to the buying centres and also facilitate easy transportation of other farm inputs.

Community benefits: AWSB has proposed financial support to implementation of community water projects in the source basin. This will see increased access to piped water supply in the project area.

Other positive impacts anticipated include creation of market for local suppliers of construction materials, opportunities of income generation activities for women in supplying food to project workers, knowledge transfer during the construction period and desirable social change.

iv. Negative Impacts

On the other hand, the proposed project will be associated with a number of negative impacts are discussed below.

Land take and resettlement: Development of the project's infrastructure – weirs, shafts and inlet/outlet portals, Githika outfall and construction camp will entail permanent land acquisition. In addition, a 3m wide wayleave has been proposed right above the 11.8km long tunnel alignment which once acquired will restrict utilization by the current owners. This will affect 177 households (with 657 persons) and 8 institutions.

Hydrology: Specialist hydrological assessment conducted during the ESIA study concluded that the project is not anticipated to have any significant impacts on hydrology. Since the design is based on flood flow of the rivers, no changes on normal flows are anticipated at all. However, frequencies of flood flows downstream will be reduced. The cumulative impacts of the project on downstream hydropower generation schemes at Masinga has also been established to be marginal with an annual average reduction of inflow of 2.32% to Masinga Reservoir, or a reduction in volume of 2.72 m³/s relative to average inflow of 125.51 m³/s (1995-1997).

Ecology: Ecological assessment of project included analysis of impacts of project-induced hydrological changes on downstream ecology of the affected rivers. Habitat requirements for rainbow trout fish *Oncorhynchus mykiss* was used as a benchmark given that they are more stringent than for the rest of encountered aquatic species. The assessment established that the proposed flow release for Maragua intake (Q95=0.481m³/sec) will meet the trout fish requirement (0.259m³/sec). However, for Irati and Gikigie rivers, the proposed downstream releases will be lower than the minimum requirements for the trout species. The proposed design for Irati is 1.4Q95=0.645 m³/sec against calculated rainbow trout fish requirement of 0.989 m³/sec while for Gikigie, the proposed design flow is Q95 = 0.101 m³/sec, against rainbow trout requirement computed to be 0.133 m³/sec. In order to meet the calculated rainbow trout fish minimum habitat requirements, hydrological analysis established that the

design flows at Gikigie and Irati intakes would require upward revisions to $1.32 \times Q_{95} = 1.33 \text{ m}^3/\text{sec}$ and $2.15 \times Q_{95} = 0.991 \text{ m}^3/\text{sec}$ respectively. However, it is notable that the calculated minimum requirements for rainbow trout from this study are higher than the naturalised mean monthly flow e.g. for Irati river and cannot be conclusively used to set the minimum ecological flow requirements. This could also mean that the rainbow trouts species is not distributed throughout all the rivers in all seasons hence the need to ensure that any migration is not impeded for continuous habitats connectivity. The study therefore recommends the implementation of the compensation flow as designed but with strict enforcement of the proposed weir operating principles.

Since the proposed project abstractions will be based on flood flow and not normal flows, there will be no effect at all on the normal flows. The anticipated reduced frequency of low-flows will be associated with some habitat loss for riverine fishes during periods of low-flows with Irati likely to be the most affected. However, no permanent riverine habitat loss is anticipated and there is no species of conservation significance that will be impacted.

Other negative impacts anticipated from the project implementation include

- Loss of vegetation cover;
- Increased demand on utility supplies and Disruption of services;
- Impacts on Soils
 - Soil erosion and increased sedimentation
 - Soil pollution
 - Soil compaction
- Occupational and General public Safety and Health Hazards
- Spread of communicable diseases;
- Pollution of (surface and ground) water resources;
- Changes in groundwater levels and flow;
- Oil spills;
- Shifting of unskilled labour force from agriculture to construction
- Waste Generation;
- Air pollution;
- Geological and seismic hazards;
- Impeded migration of migratory fishes;
- Noise and vibration pollution;
- Social delinquency, HIV/AIDS and other sexually transmitted infections;
- Immigration and emergence of unplanned settlements;
- Impacts of increased traffic volumes and tonnage; and
- Visual impacts on local landscape

Most adverse impacts associated with the project can be readily managed to acceptable levels with implementation of the recommended mitigation measures and ESMP developed in this report. Project such that the overall benefits from the Project will greatly outweigh the adverse impacts. Further, the requisite conditions for most of the mitigations have been incorporated by the proponent on project bidding documents reviewed by the consultant.

E5 Conclusion and Recommendations

This ESIA Study has been prepared to provide sufficient and relevant information on the proposed Northern Collector Tunnel Phase 1, to enable NEMA establish whether activities of the project are likely to have significant adverse environmental impacts. In addition, the report responds to the environmental assessment requirements set by the project financiers: WB and AfD.

In general, the proposed project will result in appreciable benefits to the city of Nairobi, its satellite towns and Kenya at large and bring opportunities for both social and economic development.

It is recommended that the proposed project be implemented in compliance with all the relevant legislation and planning requirements of Kenya at all times. In line with this, the proponent (AWSB) and the contractor (s) must take the legislative framework reviewed in this report into consideration, during and after the implementation of the project, as will be appropriate.

In order to meet the downstream ecological requirements, the following are recommended:

- Ensure the proposed abstraction weirs operation principles are met throughout the operation period for all rivers via continuous monitoring. Reduced abstractions during low-flow seasons achieved by this will help sustain riverine habitats during these periods;
- Construct fish passes as planned and ensure they are regularly maintained to allow safe passage for all identified migratory species;
- Ensure demarcation and protection of riparian reserves of the affected rivers. This will offer favourable cover and temperatures for the rainbow trout; and
- Undertake wet season survey and subsequent annual aquatic fauna surveys for both wet and dry seasons to monitor trends and inform any further management interventions.

Considering the aquatic species documented during this study that is the short distance migratory fish species to feed or spawn such as the *Labeo cylindricus*, *Barbus* spp. and other aquatic invertebrates) and the long distance migratory species (that use the river for feeding and spawning purposes such as the eel *Anguilla bengalensis*, *Oncorhynchus mykiss*, *Salmo trutta*), the proposed Technical fish pass is deemed adequate for this purpose as it allows possibility of migration at weirs for both strongly swimming fish and for bottom oriented and small fish.

The design should adopt a variable abstraction of water based on seasonality of flows.

The Resettlement Action Plan should be implemented before mobilisation of contractor to site. Any additional land requirements by the contractor not covered under the RAP must also be compensated for in full before actual construction begins.

1 INTRODUCTION

1.1 Project Background and rationale

Athi Water Services Board (AWSB), the Proponent, provides Water and Sewerage services in Nairobi City County and some of its satellite towns, whose water demand is increasing rapidly due to population increase into the City coupled with increased water demands from the industries. Nairobi is the country's largest economic centre and generates 45% of the country's GDP, in the process employing 43% of all Kenya's urban workers (Oxfam, 2009). It is also the largest industrial centre and food, beer, vehicles, soaps, textiles and chemicals are all produced or processed in the city.

The main source of water for Nairobi is the Eastern Aberdare Rivers within the Aberdare Conservation Area (ACA). The ACA includes the Aberdare National Park and the gazetted Forest Reserves that surround the National Park. The areas are all under Government protection through Kenya Wildlife Services (KWS) and Kenya Forest Service (KFS). They are not subject to catchment degradation through settlement and forest clearance, as has been recorded in other national forests, notably the Mau Forest. It can reasonably be assumed that the "protected area" status will not only be maintained by the Government, but will be strengthened; hence the sustainability of the surface water sources arising from the ACA is assured under current Government policy, subject to control of permitted abstraction.

The ground water contribution to Nairobi Water supply (domestic, commercial or industrial purpose) by public, private or individual boreholes is estimated to be approximately 45,000m³/day.

The present sources of water and their respective yields are as given below:

| | |
|-------------------|-----------------------------|
| • Thika Dam | 329,000 m ³ /day |
| • Sasumua Dam | 58,000 m ³ /day |
| • Ruiru | 21,700 m ³ /day |
| • (Chania) Ngethu | 104,000 m ³ /day |
| • Kikuyu Springs | 4,800 m ³ /day |

The combined yield of the developed Water sources for Nairobi Water Supply is about 540,000m³/day against the current demand estimated at about 750,000m³/day (Source: AWSB).

In order to bridge the existing supply gap and meet the projected future demand, a Feasibility Study and Master Plan for Developing New Water Sources for Nairobi and Satellite Towns up to the year 2035 was commissioned by AWSB and concluded in 2012 by Consultant Egis Bceom International in association with Mangat I.B. Patel & Partners.

The project is derived from Nairobi Water Master Plan for Developing New Water Sources for Nairobi and 13 Satellite Towns namely Kikuyu, Ruiru-Juja, Kiambu, Karuri, Githunguri, Mavoko Municipality, Ngong Township, Ongata Rongai, Thika, Gatundu, Limuru, Lari and Tala-Kangundo.

The Northern Collector Phase 1 (the Project) includes the following components:

- Transfer of water from Maragua River, Irati River and Gikie River to Thika dam (Ndakaini dam);
- Construction of raw water gravity main from Thika dam to the proposed Water Treatment Plant 6km downstream of Thika dam;

- Construction of Water Treatment Plant 6km downstream of the dam; and
- Construction of 44km Treated Water gravity main up to Kabete reservoirs (capacity 1.60m³/s) via Ngethu and Gigiri Water Treatment Plants to meet the city's year 2017 water demand.

1.2 Project Location

The proposed Northern Collector Tunnel (NCT) is located in Kangema and Kigumo Sub-Counties of Murang'a County. Murang'a town is the County Headquarters, while the Sub-County Headquarters for Kangema and Kigumo are located in Kangema and Kigumo towns respectively. A map showing the location of Murang'a County is shown in Figure 1-1.

The administrative units covered by the project are shown in Table 1-1 below and presented in Figure 1-2.

Table 1-1: Administrative units covered by the project

| Sub-County | Division | Location | Sub-Location |
|------------|-------------|-----------|--------------|
| Kangema | Kanyenyaini | Ichichi | Ichichi |
| | | Kiruri | Kiruri |
| Kigumo | Kangari | Makomboki | Makomboki |
| | | Kangari | Kangari |
| | | Mairi | |
| | Kinyona | Kinyona | Kinyona |
| | | Gacharage | Mununga |
| Gacharage | | | Gacharage |

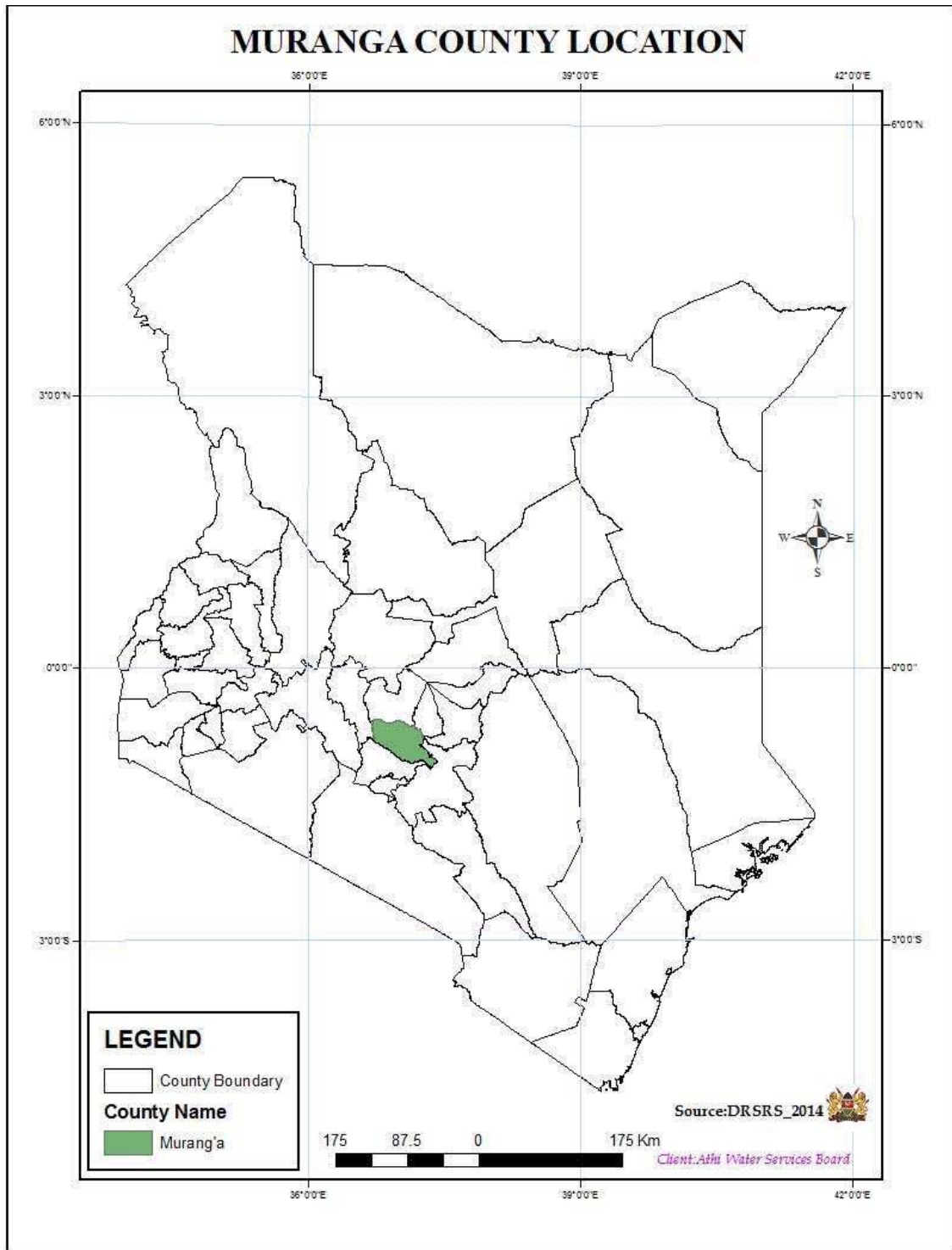


Figure 1-1: Location of the Murang'a County within Kenya

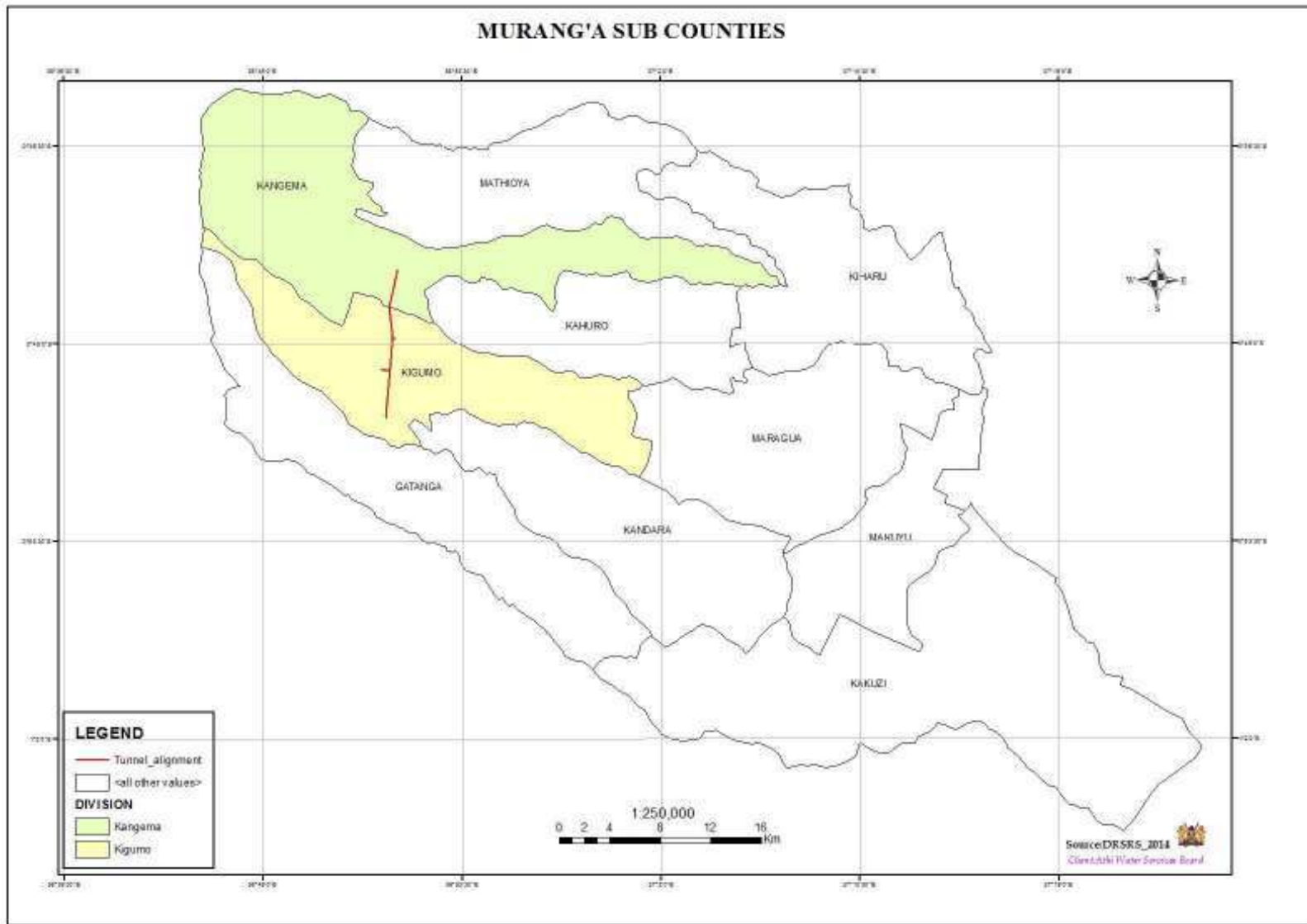


Figure 1-2: Sub counties Covered by the Project

1.3 Objectives of the ESIA study

The main objectives of the environmental and social impact study are to:

- To comply with the Environmental (Impact Assessment and Audit) Regulations, 2003, Regulations;
- Determine the sustainability of the project on environmental and social safeguards;
- Provide a baseline description of bio-physical and socio-cultural environment of the project area;
- Assess potential impacts of the project on the bio-physical and socio-cultural environment;
- Allow for consultations with all interested and affected parties and the relevant authorities; and
- Design appropriate cost based mitigation, management and monitoring measures.

1.4 Methodology

In order to meet the study objectives, the first step was for the key staff to undertake desk study and preliminary site visit. Based on the site visit observations relevant to project and which could influence the Environmental and Social Impact Assessment were identified.

1.4.1 Screening Visit

Screening is the process of assessing the viability of a project for an ESIA and evaluating the extent of assessment required. A site visit to the Project area was undertaken between 10 and 28 April 2014. The following were undertaken:

- Site analysis: Reconnaissance of the proposed location of the NCT to develop impression of topography, flora and fauna, economic activities, existing developments and potential project affected persons; and
- Meet the Sub-County Administration and the representatives of the Muranga County to allow for smooth information dissemination to the general public.

1.4.2 Project Report and Scoping

From the initial literature review, fieldwork and consultations, a Project Report was prepared and submitted to NEMA as an application for ESIA Study for the proposed project (NEMA Ref: NEMA/PR/5/2/12495). After review of the project report and determination of need for ESIA study by NEMA, TOR for this study were prepared and approved by NEMA in July 2014.

1.4.3 Desk Study

The environmental team reviewed relevant literature including but not limited to the following reports:

- Final Design Report for the Northern Collector Tunnel Phase 1;
- Northern Collector Tunnel (NCT) - Phase 1 Part 2: Works Requirements – Drawings;
- Geotechnical reports and data;
- Feasibility and Master plan reports for developing new water sources for Nairobi and satellite towns; and
- Preliminary EIA for the Northern Collector Tunnel Phase 1.
- Various Policies, Acts and Regulations pertinent to the environmental assessment of the project. These included but not limited to the following:
 - The Constitution of Kenya, 2010;
 - The Environment Management and Coordination Act, 1999;
 - Wildlife (conservation and Management) Act 2013;
 - The Occupational Safety and Health Act, 2007;
 - Work Injury Benefits Act (WIBA);
 - Employment Act;
 - The County Governments Act 2012;
 - Urban Areas and Cities Act No. 13 of 2011;
 - The Penal Code (Cap. 63);
 - The Public Health Act (Cap. 242);
 - The Water Act 2002;
 - Strategy for Revitalization of Agriculture (SRA 2004-2014);
 - National Environment Action Plan 2009 – 2013;
 - The National Policy of Water, Sessional Paper No. 1 of 1999;

- The National Poverty Eradication Plan (NPEP), 1999 ;
- Kenya’s Vision 2030; and
- Millennium Development Goals (MDGs).

A Complete bibliography is presented in chapter ten of this report.

1.4.4 ESIA Study

With all the aforementioned information, a field study was undertaken from August to September 2014 to evaluate the types, mode of action and magnitude of the specific projected effects and impacts, both favourable and detrimental to the environment and natural resources. This encompassed further assessment of proposed water intake points, Outfall area and neighbourhood, hydrological assessment, ecological survey, and detailed socioeconomic survey.

Second round of consultations with stakeholders identified at the screening stage including public meetings was also conducted.

1.4.5 Ecological Surveys

Both quantitative (field sampling) and qualitative (desk-stop literature review) on biodiversity in rivers of the study area methods were employed. Quantitative surveys were conducted from 11 to 15 August 2014 as shown below.

| River/section covered | Survey date | Comments |
|--|----------------|--|
| Githika | 11 August 2014 | Near proposed intake |
| Irati | 12 August 2014 | Near proposed intake |
| Gikigie | 13 August 2014 | Near proposed intake |
| Maragua near intake works | 14 August 2014 | Near proposed intake |
| Maragua and Tana Confluence | 15 August 2014 | After Tana HEP station |
| Maragua just before Wanjii HEP station | 15 August 2014 | After confluences with Irati and Gikigie |

(a) Qualitative method- Desk stop study and indigenous knowledge on aquatic fauna of the study area

- A detailed literature review on past studies on biodiversity in rivers of the study area was undertaken from published papers, technical reports from Ministry of Fisheries and other Government agencies such as National Museums of Kenya, KWS or Non-Government organizations; and
- Open ended questions were used to gain indigenous knowledge on aquatic fauna from the local people. This included interviewing the local people living around each of the rivers as well as fishermen. Other independent sources included some Government officials resident in the area, for example the Ken-Gen staff at Wanjii reservoir.

(b) Quantitative methods

(i) Field sampling design

- A reconnaissance survey was initially carried out before commencement of actual fieldwork necessary to determine accessibility in the study area and to locate the exact sampling points.
- Stream reaches along the river sites each about 100m long, were established in the 6 sampling sites namely; upstream of the rivers Maragua intake (Site 1), Gikigie (Site 2), Irati (Site 3) and the down stream site of the project area which is river Githika outlet (Site 4),

Lower R. Marangua (5) and the confluence of Tana river (Site 6) to sample fish and aquatic macro- invertebrates in an upstream direction. 3 stream reaches in each site about 50m apart were randomly selected depending on accessibility, length of river, altitude and ecological settings/biotope types (e.g. riffles and pools sequence, macrophytes or minor river joining main river, etc). Along each reach, at least 4 belt transects/sampling points (riffle-pool) perpendicular to the river channel were randomly selected and 3 scoops (in the left bank, middle and right bank of stream) using pond scoop nets or dip-nets with 0.5mm mesh size) were randomly drawn to sample the aquatic macro-invertebrates.

- For fish sampling, at least two transects per reach site were randomly selected and fishing nets (gill nets) and beach seines deployed while backpack electrofisher dipnet/hoop net was deployed in the four transects above for macro-invertebrate sites (riffle-pool sequence) considering the depth of the river.
- Water quality parameters that were sampled in each sampling point using an Hydro-lab included Temperature, PH, Dissolved Oxygen (DO), Turbidity, Conductivity, Salinity, Nitrates and Phosphates.
- Each sampling site was geo-referenced using a hand-held Geographic Positioning System (GPS) for future repeated monitoring particularly to compare seasonality.

(ii) Aquatic fauna sampling techniques

A combination of different sampling methods/fishing techniques were employed in this study including; fishing nets of different mesh sizes, beach seines, backpack electro-fisher, pond netting or dip-nets and aerial sweep-netting for flying aquatic insects e.g. dragon and damsel flies, mayflies, etc whose larvae are aquatic in all the sites.

(iii) Fish sampling techniques

Fishing nets, beach seines, backpack electro-fisher or fish anglers

Nylon monofilament gillnets of varying mesh sizes ranging from 8-50 mm, Beach seine nets (e.g. 4m long, 0.5m deep), dip-nets (e.g. 60cm x 60cm x 75cm; small dimension 25 cm broad), an electro-fisher or baited fish anglers were used to catch the fish. Electro-fishing is known to be ideal if conductivity > 30 μ S/cm; temperature > 4°C at time of sampling; and water visibility > 25 cm. Fish anglers were tried for the rainbow trout. Representative samples and unidentified fish species were collected and recorded, preserved in formalin (10%) for further identification in the laboratory at National Museums of Kenya (NMK) and later preserved in alcohol (70%) as permanent reference collections at NMK. Additional information was obtained from local fishermen on fishes of these rivers.



Figure 1-3: Mountain catfish *Amphilius uranoscopus* at R. Githika

(iv) Macro-invertebrates sampling methods

Pond netting for aquatic macro-invertebrates and baited crab traps

A pond net (0.5mm mesh size) was used to scoop the benthic area and all materials were transferred into a sorting tray. Crabs or any other crustacean were removed from the crab traps and voucher specimens taken. From the tray, representative invertebrate samples were collected into specimen vials containing 70% ethanol for further identification in the NMK laboratory.



Figure 1-4: Sampling of aquatic macro-invertebrates at R. Maragua Black fly *Simulium* sp larvae in riffle rocks

Aerial Sweep netting

Sweep netting was employed targeting the flying adult aquatic insects e.g. dragon flies, damsel flies, etc and those resting in vegetation. This method entailed trapping flying insects using a sweep net for fixed periods of 1 hour at selected sampling sites and some specimens were identified instantly on site while those that were not identified on site were kept in butterfly envelopes awaiting further identification in the laboratory. The collected insects were then preserved in vials containing 70% ethanol.

(v) Water quality parameters

Water quality parameters sampled included water Temperature, Dissolved Oxygen, conductivity, PH, Turbidity, Nitrates, Phosphates, salinity. Also water depth, width of the river and water velocity (and multiplied by 0.8 to provide an estimate of mean velocity; Allan, 1995) were measured.



Figure 1-5: Measuring water quality parameters in a pool and sampling of fish using Electrofisher in a riffle

(vi) Others- Small mammals, amphibians and reptiles

Occurrence of other aquatic fauna including small mammals such as the otters, etc was observed visually or captured and also indigenous knowledge information were sought from the local people. Large reptiles such as monitor lizards were noted while amphibians such frogs were also collected alongside the macro-invertebrates and fish and preserved in formalin for further identification at National Museums of Kenya (NMK) laboratory.

(vii) Fish and invertebrates identification

Most of the collected fish and invertebrates were identified on site to genus level or higher taxa and those that could not be identified to species level were kept in labeled specimen vials and butterfly envelopes and later

transported to NMK for further identification using keys and scientific reference collections.

(c) Other fauna

Other animals like mammals; birds; amphibians; and reptiles were identified or presence confirmed through:

- Visual sighting;
- Spoons;
- Droppings;
- Photography;
- Transects walk;
- Hairs/feathers;
- Animal diggings; and
- Local knowledge.

(d) Plants

Plants were sampled within the river reaches in transects as for fish and aquatic macro-invertebrates above. In each transect a triplicate of sample plots measuring at least 20m x 20m were demarcated depending on the width of the river. Plots were located at least 30m apart to ensure sample independence. Each sampling zones were geo-referenced using GPS and all vegetation occurring within a plot/enclosure was identified and recorded. Samples that could not be identified in the field were pressed for later identification at NMK Herbarium.

1.4.6 Impacts on biodiversity

The biodiversity information generated from the above baseline survey formed the basis for the identification and analysis of potential impacts from the project implementation. This included vital information on the conservation status or endemism of the identified aquatic animal and plant species in the area which was evaluated for conservation risks according to IUCN Red-list of threatened species or CITES or Wildlife Conservation and Management Act.

Additionally, the information generated on the water quality parameters provided the water requirements/demand of the various aquatic biota species.

1.4.7 Hydrology

Hydrological assessment involved a detailed review of the documentation from the previous hydrological studies done for the project, especially the feasibility studies by Howard and Humphreys (1998) and the Egis and Mangat (2012), and the detailed design reports by SMEC International (2013). This was to note and appreciate what had been done and where necessary get some of the data and equations used for data extension.

River flow data for the years 2011-2013 was collected from WRMA and KenGen for the three rivers Irati, Gikigie and Maragua. The flow data used by Egis and Mangat which had been extended up to the year 2010 was obtained from the reports and the same was extended to cover the years 2011-2014 and used for the analysis.

The River Gauging Stations (RGS) used for the study and their coordinates are as follows;

- RGS 4BE01 – Maragua River (Grid Reference BK 960172);
- RGS BE3 – Irati River (Grid Reference BK785132);

- RGS 4BE8 – Gikigie River (Grid Reference BK598203);
- RGS 4BE9 – Maragua River (Grid Reference BK 624214)

The data were subjected to analysis including flow naturalisation, dependability analysis for the characterisation of the Project Rivers.

Projection of future downstream water requirements and environmental flow requirements were then determined to facilitate impacts identification and analysis by comparing hydrologic regimes before and after (with the project) the system has been altered.

1.4.8 Mapping of Baseline Environment

Spatial data for mapping was collected through:

- Hand-held GPS equipment; and
- Collection and purchase of base maps.

Using Computer Aided Mapping technologies, graphic presentations were prepared as part of the output on the NCC baseline environment. Data processing involved:

- Raw data conversion, cleaning etc;
- Digitization of dams and other AOI from scanned topographical maps at 1:50,000 e.g. main rivers, Thika dam, noise and ecological sample points, and Hydro-power stations. major urban centres etc; and
- All shape files were projected to UTM zone 37N.

All GIS maps were prepared in ARCGIS10.1 and exported as JPEG for documentation and presentation. The maps unless otherwise stated were generated at the scale of 1:130,000. In some cases however, sections of selected maps were blown out to highlight specific areas of interest.

1.4.9 Socioeconomic Survey

The sampling method employed in this survey was based on the understanding that households are not homogenous particularly in terms of levels of farm utilization, livelihood challenges, socio-economic values attached and development concerns and threats. The main sampling unit of the survey was the household.

The team consulted the area Chiefs, sub-chiefs and village elders to identify the villages and households in the primary project's primary zone of influence. Cluster sampling strategy was then employed in the selection of the households based on the household listing provided by the chief and village elders. The number of households enumerated per village is as shown in Table 1-2 below.

Table 1-2: Sampled Households by village

| Village | HHs sampled | Village | HHs sampled |
|--------------|-------------|----------------|-------------|
| Gathai | 2 | Karura | 1 |
| Gathaiti | 1 | Kiaro | 1 |
| Gathure | 1 | Kinyona | 2 |
| Gikigie | 2 | Kirangi | 1 |
| Gikohokoho | 2 | Magomano | 8 |
| Gitaigua | 13 | Mainungi | 1 |
| Gitoka | 3 | Mairi | 10 |
| Gituamba | 11 | Makomboki | 6 |
| Ichichi | 16 | Muchagatha | 10 |
| Irati | 1 | Munyoroku | 3 |
| Kagimbi Ini | 2 | Ndirimi | 1 |
| Kaihuri | 6 | Ngecha | 6 |
| Kamunyaka | 6 | Njikairo | 2 |
| Kangari | 10 | Rugongo | 2 |
| Karuga | 1 | Rugongo Ruraya | 1 |
| Total | | HHs 132 | |

The response rate was 100%

Additionally, a targeted survey was done for PAPs within the intakes, outfall and the tunnel alignment. A total of 171 households were enumerated. However, since these households were identified purely on the basis of them being affected by the land take, data from these households was not included in the analysis as it would interfere with the distribution.

The resultant data was coded uniformly for data entry purposes. The data was then entered and analyzed using the SPSS program. Quantitative data analyses were carried out using simple and relevant statistical methods such as average, percentage and frequency distribution.

1.4.10 Public Consultations

(a) Project Report Stage

Consultations with the Sub-County administration in Kangema and Kigumo Sub-Counties were done during the preliminary field visits to notify them of the proposed project as well as to aid in further identification of relevant local institutional stakeholders to be consulted during the ESIA study.

(b) ESIA Study Stage

Further public consultations were undertaken during the full environment and social impact assessment study to document the social impacts to the project

area and general community perceptions on the project based on final project designs.

In general, the following steps were followed in carrying out the entire consultation and public participation process:-

- Identification of institutions and individuals interested in the process and compiling a database of the interested and affected parties
- Administration of questionnaires to different target groups and local community members within the proposed project site.
- Public / Technical Meetings at various levels and with different target groups

The public participation exercise was conducted in four ways, namely;

- 6 No. General public meetings from 11 to 14 August 2014;
- Key Informant Interviews and six (6) Focus Group Discussions;
- Social economic surveys and observations; and
- Public disclosure workshop.

(i) Public meetings

Consultations with the communities were conducted in the project area with the help of the local administration including the Deputy County Commissioners, Assistant County Commissioners, chiefs and assistant chiefs. The discussions during these public meetings were centered on key emerging issues relating to the project as well as the communities. Given the large size of the project area, a total of six (6) meetings were held at location levels within the project area.

(ii) Key Informant Interviews

One-on-one interviews with civil, government agencies and other institutions in the project area, from both Kigumo and Kangema sub counties as well as with various bulk water service providers, were undertaken to assist in analysis of impacts to the community and institutions in the project area. These interviews were conducted to augment and confirm data and information obtained using the other tools and methodologies.

(c) Incorporating public views into the ESIA report

Views of those affected by or interested in the project informed identification and evaluation of both social and environmental impacts and have also been considered in the formulation of mitigation measures and formulation of the environment management plan.

(d) Public disclosure

This involves disclosure of findings, conclusions and recommendations of ESIA report to stakeholders and public. Findings of the ESIA report were disclosed during a stakeholders' workshop held on 2 October 2014 at Nokras hotel in Murang'a town.

The consultations feedback is presented in chapter six and records are provided as Appendix VI.

1.5 Study Limitations

Due to limited time for the study, primary aquatic ecology data collection only took place during a dry season only. However, inputs from local knowledge were used to corroborate secondary information on species in the area. Dry season survey presents an opportunity to record fauna which are usually available even during low flow conditions. Low flows are stressful for fish and other aquatic life, as habitat availability is reduced, water quality may be changed and food sources may decrease.

1.6 ESIA Study Team

The ESIA team comprised the following:

| | |
|-----------------------|--|
| Eng. Maurice Namiinda | Project Director and Water Supply Engineer |
| George G Owuor | Team Leader and Lead Environmentalist |
| Anastasia Ngatti | Assistant team leader |
| Aggrey O. Kwadha | Environmentalist |
| George Wandera | Sociologist |
| John Kochey | Aquatic Ecologist |
| John Nyangaga | Hydrologist |
| Jacob Omondi | Assistant sociologist |
| Michael Kabari | Assistant environmentalist |
| Vincent Imala | GIS Expert |

1.7 Structure of the Report

This report has been prepared under the following chapters:

Executive summary: This chapter presents a summary of the significant findings and recommended actions, with an emphasis on expected impacts.

Chapter 1: **Introduction:** This chapter gives description of the project background, location, purpose, objectives, study methodology and the structure of the report.

Chapter 2: **Policy, Legal and regulatory framework:** This chapter outlines the overview of legislative framework, regulatory, international guidelines and conventions relevant to this project.

Chapter 3: **Baseline Environmental setting:** This chapter gives description of the pre-project environmental setting of project and surrounding areas, e.g., climate, soils, geology, vegetation, fauna, land use, human populations, socio-economics, cultural heritage.

Chapter 4: **Project description:** This chapter gives a description of the project details and design and implementation strategies.

Chapter 5: **Project alternatives:** This chapter gives an analysis of project

alternatives including the no-project option.

- Chapter 6: **Public and stakeholder consultation:** This chapter gives description of the objectives, methods used and summary of results of the public consultation activities undertaken during the project report stage.
- Chapter 7: **Impacts Assessment and Mitigations:** This chapter presents the analysis of beneficial and adverse impacts of the project on the biophysical and human (social, cultural and economic) environments. The analysis covers anticipated impacts during the construction, operation phases and decommissioning phases and also describes the enhancement and mitigation measures proposed to enhance benefits or prevent, minimize, mitigate or compensate for adverse impacts as well as the estimated cost of mitigation.
- Chapter 8: **Environmental and Social Management Plan:** This chapter gives in details summary of procedures and plans to ensure that the mitigation measures and monitoring requirements approved during the environmental compliance review will actually be carried out in subsequent stages of the project.
- Chapter 9: **Conclusions and Recommendations:** This chapter summarises the consultant's conclusion and recommendations from the assessment.

2 POLICY, LEGAL AND REGULATORY FRAMEWORK

2.1 Background

Regulation 18 (1) (b) of the Environmental (Impact Assessment and Audit Regulations) 2003 require an environmental assessment study report to, among others; include a concise description of national environmental legislative and regulatory framework. This chapter presents a review of the current policy, legal and regulatory framework applicable to environmental management of the proposed NCT1 both at local and international levels.

2.2 Policy Framework

2.2.1 Environmental Policy

Sessional Paper No. 6 of 1999 on Environment and Development since adoption by parliament in 1999 has been in use and influenced the formation of EMCA in 1999. However, since it has been surpassed by time it is therefore under revision to comprehensively cover areas that were previously left out to augment it.

The revised draft of the National Environmental Policy, dated April 2012, sets out important provisions relating to the management of ecosystems and the sustainable use of natural resources, and recognizes that natural systems are under intense pressure from human activities particularly for critical ecosystems including forests, grasslands and arid and semi-arid lands. The objectives of the Policy include developing an integrated approach to environmental management, strengthening the legal and institutional framework for effective coordination, promoting environmental management tools, supporting the implementation of the Forests Act 2005, and developing national standards and appropriate forest-based development mechanisms in emerging carbon markets.

Relevance

This ESIA study has developed an ESMP for the project which should be implemented to mitigate the resulting impacts during the construction and implementation phases of the project. This will ensure that the sensitive ecosystems are not destabilised by the subsequent project activities, especially the downstream uses of the rivers.

2.2.2 Kenya's Vision 2030

Vision 2030 aspires to transform Kenya into a newly industrialized middle-income country by 2030. The blueprint recognizes that Kenya is a water scarce country and further that the economic and social development envisaged in the vision 2030 will require more high quality water supplies. The water and sanitation sector goal in line with the Vision 2030 is *"to ensure that improved water and sanitation are available and accessible to all"*.

One of the strategies proposed is to construct water and sanitation facilities to support industries and the growing urban population.

Regarding environment, the Vision states that Kenya aims to be a nation living in a clean, secure and sustainable environment by 2030. The goals for 2012 are: (i) to increase forest cover from less than 3% at present to 4%; and (ii) to lessen by half all environment related diseases. Specific strategies involve: promoting environmental conservation for better support to the economic pillar flagship projects and for the purposes of achieving the Millennium Development Goals (MDGs); improving pollution and waste management through the design and application of economic incentives; and the commissioning of Public-Private Partnerships (PPPs) for improved efficiency in water and sanitation delivery.

Relevance

The NCT project is in line with the vision 2030 and specifically falls under the flagship project of rehabilitating and expanding urban water supply and sanitation in Nairobi and its key satellite towns which have been identified for various economic and social flagship projects.

2.2.3 Land Policy

The National Land Policy in Chapter 3 under section 3.4, Environmental Management Principles, provides for the policy actions for addressing the environmental problems such as the degradation of natural resources, soil erosion, and pollution of air, water and land.

The policy advocates for environmental assessment and audit as a land management tool to ensure environmental impact assessments and audits are carried out on all land developments that may degrade the environment and take appropriate actions to correct the situation. Public participation has also been indicated as key in the monitoring and protection of the environment.

Section 3.4.3.3 advocates for the Implementation of the polluter pays principle which ensures that polluters meet the cost of cleaning up the pollution they cause, and encourage use of cleaner production technologies.

In section 131 (d) the government undertakes to provide mechanisms for resolving grievances arising from human/wildlife conflicts for sustainable management of land based natural resources.

Relevance

The proposed works shall implement the ESMP from this environmental assessment to ensure that all the rivers and streams within the project area are not polluted by the subsequent activities during construction and operational phases.

2.2.4 National Water Policy

The National Water Policy was promulgated in April 1999 as Sessional Paper No. 1 of 1999 and calls for decentralization of operational activities from the central government to other sectors, including local authorities, the private sector and increased involvement of communities in order to improve efficiency in service delivery.

The overall objective of the National Water Policy is to lay the foundation for the rational and efficient framework for meeting the water needs for national economic development, poverty alleviation, environmental protection and social well-being of the people through sustainable water resource management. The policy recognizes importance of Water resources in determining the economic and social development agenda in Kenya and also as a vital element in maintaining the ecosystem, wildlife and recreation, hydropower production, and maritime transportation.

Under the policy objective, *‘To ensure a comprehensive framework for promoting optimal, sustainable, and equitable development and use of water resources for livelihoods of Kenyans’*, the policy encourages enhancement of inter-basin water transfer in Kenya as a strategic intervention for optimized use of water resources. It recognizes that some areas in the country are less endowed with water resources, and accordingly, the Regulatory Authority shall play a major role in the conservation and equitable distribution in national interest and in the realization of the right to water.

Under the policy objective, *‘To progressively achieve universal rights to water supply and sanitation for all by 2030 in the rural and urban areas’*, one of the policy statements is to ensure access to water and sanitation according to rights. All relevant public sector institution and each WSP shall progressively enhance the rights to safe, reliable and affordable water and sanitation for all (100% service coverage by 2030)

Relevance

The proposed project is in line with this sectoral policy as it will involve inter-basin transfer and also serve to increase access to water in be beneficiary urban centres.

2.2.5 Millennium Development Goals (MDGs)

Adopted by world leaders in the year 2000 and set to be achieved by 2015, the Millennium Development Goals (MDGs) provide concrete, numerical benchmarks for tackling extreme poverty in its many dimensions. The MDGs also provide a framework for the entire international community to work together towards a common end making sure that human development reaches everyone, everywhere. If these goals are achieved, world poverty will be cut by half, tens of millions of lives will be saved, and billions more people will have the opportunity to benefit from the global economy.

Goal 7 of the MDGs is on ensuring Environmental Sustainability. It highlights on the following issues that need to be addressed:

- Protection of forest ecosystems;
- Need for reduction in Green House Gases;
- Reduce overexploitation of marine resources;
- Promoting Non extinction of some animal species;
- Improve access and quality of water especially to the poor; and
- Try and face out the sprawling of urban slums.

Relevance

The proposed project will contribute to alleviating rural poverty while this ESIA study has been done for the proposed project to ensure that it reflects Environmental Sustainability especially during the time of construction and implementation.

2.3 Legal Framework

2.3.1 Constitution of Kenya

In article 69 of the Constitution of Kenya, 2010, the State clearly undertakes to carry out the following:

- a) Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits;
- b) Work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya;
- c) Protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities;
- d) Encourage public participation in the management, protection and conservation of the environment;
- e) Protect genetic resources and biological diversity;
- f) Establish systems of environmental impact assessment, environmental audit and monitoring of the environment;
- g) Eliminate processes and activities that are likely to endanger the environment; and
- h) Utilise the environment and natural resources for the benefit of the people of Kenya.

Section 42 states that *“Every person has the right to a clean and healthy environment, which includes the right:*

- a) To have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those contemplated in Article 69; and
- b) To have obligations relating to the environment fulfilled under Article 70

The constitution also emphasizes on that:

- Land use and management shall by law benefit local communities;
- Community land is protected from encroachment by State;
- Law shall protect Rivers, forests and water bodies;
- Equitable access to land;
- County governments will manage land in trust of the people in accordance with the Proposed Constitution.

Relevance

The constitution of Kenya provides for sound environmental management and sustainability and therefore this study provides one of the tools through which this can be achieved within the development.

2.3.2 The Environment Management and Coordination Act, 1999

The Environment Management and Coordination Act (EMCA), 1999 provides for the establishment of an umbrella legal and institutional framework under which the environment in general is to be managed. EMCA is implemented by the guiding principle that every person has a right to a clean and healthy environment and can seek redress through the High court if this right has been, is likely to be or is being contravened.

Section 58 of the Act makes it a mandatory requirement for an EIA study to be carried out by proponents intending to implement projects specified in the second schedule of the Act. Such projects have a potential of causing significant impacts on the environment. Similarly, section 68 of the same Act requires operators of existing projects or undertakings to carry out environmental audits in order to determine the level of conformance with statements made during the EIA study. The proponent is required to submit the EIA and environmental audit reports to NEMA for review and necessary action.

Relevance

Environmental Management and Coordination Act (EMCA), 1999 in its Second Schedule 4 (b) requires river diversions and water transfer between catchments undergo Environmental Impact Assessment (EIA). This report has been compiled to comply with EMCA and the Environmental (Impact Assessment and Audit) Regulations, 2003.

EMCA has provided for the development of several subsidiary legislations and guidelines that govern environmental management which are relevant to the proposed project as reviewed below.

(a) Environmental Impact Assessment and Audit Regulations 2003

The Environmental Impact Assessment and Audit Regulations state in Regulation 3 “the Regulations should apply to all policies, plans, programmes, projects and activities specified in Part IV, Part V, and the Second Schedule of the Act. Part III of the Regulations indicates the procedures to be taken during preparation, submission and approval of the study report (This report).

Regulation 4(1) further states that:

“...no Proponent shall implement a project:

(a) Likely to have a negative environmental impact; or

(b) For which an environmental impact assessment is required under the Act or these Regulations, unless an environmental impact assessment has been concluded and approved in accordance with these Regulations...”

Relevance

This ESIA study report has been prepared in response to provisions of these regulations.

(b) The Environmental Management and Co-ordination Act (Water Quality) Regulations, 2006)

These Regulations were published in the Kenya Gazette Supplement No. 68, Legislative Supplement No. 36, and Legal Notice No. 120 of 29 September 2006. The Regulations provide for sustainable management of water resources including prevention of water pollution and protection of water sources (lakes, rivers, streams, springs, wells, and other water sources). It is an offence under Regulation No. 4 (2), for any person to throw or cause to flow into or near a water resource any liquid, solid, or gaseous substance or deposit any such substance in or near it, as to cause pollution.

Regulation No. 11 further makes it an offence for any person to discharge or apply any poison, toxic, noxious or obstructing matter, radioactive waste or other pollutants or permit the dumping or discharge of such matter into the aquatic environment unless such discharge, poison, toxic, noxious or obstructing matter, radioactive waste or pollutant complies with the standards for effluent discharge into the environment as contained in the third schedule to the regulations.

The ninth schedule of the regulations stipulates the standards for sources of irrigation water as presented in Table 2-1 below.

Table 2-1: EMCA standards for sources of domestic water

| Parameter | Guide Value (Maximum allowable) |
|---------------------------|--|
| pH | 6.5 – 8.5 |
| Suspended solids | 30 (mg/l) |
| Nitrite – NO ₃ | 10 (mg/l) |
| Ammonia – NH ₃ | 0.5 (mg/l) |
| Nitrate – NO ₂ | 3 (mg/l) |
| Total dissolved solids | 1200 (mg/l) |
| <i>Ecoli</i> | Nil/100ml |
| Fluoride | 1.5 (mg/l) |
| Phenols | Nil (mg/l) |
| Arsenic | 0.01 (mg/l) |
| Cadmium | 0.01 (mg/l) |
| Lead | 0.05 (mg/l) |
| Selenium | 0.01 (mg/l) |
| Copper | 0.05 (mg/l) |
| Zinc | 1.5 (mg/l) |
| Alkyl benzyl sulphonates | 0.5 (mg/l) |
| Permanganate Value (PV) | 1.0 (mg/l) |

Relevance

During the operation and maintenance phases, the proposed water transfer from the three rivers will require compliance with the standards established under these regulations.

During the studies, water sampled from the proposed intake points were analysed from NMK and University of Nairobi laboratories and found suitable for intended use. Further, the water will be treated after transfer from Thika dam at the proposed Kigoro water treatment plant.

(c) The Environmental Management and Co-ordination (Waste Management) Regulations, 2006

These Regulations were published in the Kenya Gazette Supplement No. 69, Legislative Supplement No. 37, and Legal Notice No. 121 of 29th September 2006. The regulations provide details on management (handling, storage, transportation, treatment, and disposal) of various waste streams including:

- domestic waste;
- industrial waste;
- hazardous and toxic waste;
- pesticides and toxic substances;
- biomedical wastes; and
- Radioactive waste.

Regulation No. 4 (1) makes it an offence for any person to dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle.

Regulation 6 requires waste generators to segregate waste by separating hazardous waste from non-hazardous waste for appropriate disposal. Regulation 17 (1) makes it an offence for any person to engage in any activity likely to generate any hazardous waste without a valid Environmental Impact Assessment license issued by NEMA.

Relevance

The proposed project, during construction, will generate substantial volumes of spoil materials among other wastes which will need to be disposed as per the guidelines in the regulations.

(d) The Environmental Management and Coordination Act (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

These regulations were published as legal Notice No. 61 being a subsidiary legislation to the Environmental Management and Co-ordination Act, 1999. The regulations provide information on the following:

- i. Prohibition of excessive noise and vibration;
- ii. Provisions relating to noise from certain sources;
- iii. Provisions relating to licensing procedures for certain activities with a potential of emitting excessive noise and/or vibrations; and
- iv. Noise and excessive vibrations mapping.

According to regulation 3 (1), 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.

Regulation 4 prohibits any person to (a) make or cause to be made excessive vibrations that annoy, disturb, injure, or endanger the comfort, repose, health, or safety of others and the environment; or (b) cause to be made excessive vibrations that exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source.

Regulation 5 further makes it an offence for any person to make, continue or cause to be made or continued any noise in excess of the noise levels set in the First Schedule to these Regulations, unless such noise is reasonably necessary to the preservation of life, health, safety or property.

The First and Second schedules of the regulations have set standards for maximum permissible noise levels at construction sites and intrusive noise levels respectively.

Relevance

Various tunnel construction activities will generate noise and vibrations. The contractor will be required to ensure compliance with the above regulations in order to promote a healthy and safe working environment throughout the construction phase. Most settlements in the project lie along the roads some of which will be used to haul the anticipated high volumes of spoil and relevant noise limits will have to be observed.

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

This is a supplementary legislation to EMCA with particular emphasis on management of wetland and wetland resources, river banks, lake shores and Sea shores. Sections 4 and 5 of Part II as well as sections 16, 17, 18 of part III of the legislation provide guidelines for conservation and sustainable use and conservation of the said environmental components, and enhance them where necessary when carrying out any activity therein.

Relevance

The NCT will, in operation; continuously abstract water from the three rivers and restructure sections of their banks at particular spots through intake works. It is thus paramount that this legislation be integrated during planning, construction and operation of the project.

(f) The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006

This regulations aim at enhancing preservation of biodiversity and safeguarding of endangered and rare plant and animal species within any human activity area.

Section 4 of the legislation expressly prohibits any activity which may have adverse effects on any ecosystem, lead to introduction of alien species in a given area or result in unsustainable utilization of available ecosystem resources.

Relevance

A detailed assessment of the likely impacts of the NCT on aquatic biodiversity in the targeted rivers has been conducted to ensure their sustainability.

(g) Environmental Management and Coordination (Fossil Fuel Emission Control) Regulations 2006

These regulations are described Legal Notice No. 131 of the Kenya Gazette Supplement no. 74, October 2006 and apply to all internal combustion engine emission standards, emission inspections, the power of emission inspectors, fuel catalysts, licensing to treat fuel, cost of clearing pollution and partnerships to control fossil fuel emissions. The fossil fuels considered are petrol, diesel, fuel oils and kerosene.

These regulations will be applicable to equipment and machinery used by the contractor during tunnel construction.

2.3.3 The Water Act, 2002

The Water Act No. 8 of 2002 provides for the management, conservation, use and control of water resources and for acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services. Section 18 of this Act provides for national monitoring and information systems on water resources. Following on this, sub-Section 3 mandates the Water Resources Management Authority (WRMA) to demand from any person or institution, specified information, documents, samples or materials on water resources. Under these rules, specific records may require to be kept by a site operator and the information thereof furnished to WRMA.

Section 73 of the Act provides that a person who is licensed to supply water have a responsibility of safeguarding the water sources against degradation. According to section 75 (1) such a person is required to construct and maintain drains, sewers and other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing pollution of water sources within his/her jurisdiction.

Section 94 of the Act makes it an offence to throw or convey or cause or permit to be thrown or conveyed, any rubbish, dirt, refuse, effluent, trade waste or other offensive or unwholesome matter or thing into or near to water resource in such a manner as to cause, or be likely to cause, pollution of the water resource.

Relevance

The proponent should ensure that a Water abstraction permit for the project is obtained from WRMA. The proponent will be required to ensure that project activities throughout all phases do not cause pollution of the water resources and also continuously monitor the quantity and quality of water being abstracted from the rivers.

(a) The Water Resources Management Rules, 2007

As a subsidiary to the Act, a legislative supplement, The Water Resources Management Rules, 2007 was gazetted to guide all policies, plans, programmes and activities that are subject to the Water Act, 2002. The Water Resources Management Rules empower Water Resources Management Authority (WRMA) to impose management controls on land use falling under riparian land. It also enables any person with a complaint related to any matter covered by these rules to the appropriate office in WRMA as per the Tenth Schedule which provides a format for report on complaints.

Part A of the Sixth Schedule: Conservation of Riparian and Catchment Areas of the Rules (rule 116) define the riparian land on each side of a watercourse as a minimum of six metres or equal to the full width of the watercourse up to a maximum of thirty metres on either side of the bank. It further provides activities proscribed on riparian land as:

- Tillage or cultivation;
- Clearing of indigenous trees or vegetation;
- Building of permanent structures;
- Disposal of any form of waste within the riparian land;
- Excavation of soil or development of quarries;
- Planting of exotic species that may have adverse effect to the water resource;
- or
- Any other activity that in the opinion of the Authority and other relevant stakeholders may degrade the watercourse.

Rule 63 provides for Compensation flow and a permit holder storing or arresting the flow of water by means of a dam or weir located on a body of water or watercourse shall unless otherwise decided by WRMA, provide at a depth measured from the top of the dam or weir and to be specified by WRMA in each particular case, an outlet,

controlled by a valve, sluice gate or other device, which shall be capable of being operated at all stages of the flow of such body of water or watercourse so that the normal flow, or other flow as required by WRMA, of such body of water or watercourse can be passed through or around such dam or weir at all stages.

Relevance

The project will arrest flows of rivers Gikigie, Maragua and Irati by means of weirs and the design has to allow for adequate compensation flow through the proposed weirs in line with these rules and any other WRMA requirements.

2.3.4 The Public Health Act (Cap. 242)

This is an Act of Parliament to make provision for securing and maintaining health. Section 115 of this act prohibits causing nuisance or other conditions liable to be injurious or dangerous to health. Section 118 provides a list of nuisances that includes any noxious matter, or wastewater, flowing or discharged from any premises, wherever situated, into any public street, or into the gutter or side channel of any watercourse, irrigation channel or bed thereof not approved for the reception of such discharge.

(a) The Public Health (Drainage and Latrine) Rules

Rule 85 provides that every owner or occupier of every workshop, workplace or other premises where persons are employed shall provide proper and sufficient latrines for use by employees. Rule 87 requires every contractor, builder or other person employing workers for the demolition, construction, reconstruction, or alteration of any building or other work in any way connected with building to provide in an approved position sufficient and convenient temporary latrines for use by such workers. Rule 91 provides that no person shall construct a latrine in connection with a building other than a water closet or a urinal, where any part of the site of such building is within 200 feet of a sewer belonging to the local authority that is at a suitable level, and where there is sufficient water supply.

Relevance

The project construction and operation activities are bound to expose both workers and members of the general public to situations injurious to health. All activities of the project are thus expected to abide by this act to ensure a healthy environment.

2.3.5 Malaria Prevention Act Cap 246

This is an act of parliament which enables health authorities to take measures for prevention of Malaria.

Section 5 of the act prohibits operations that obstruct flow of water into or out of any drainage without the approval of the health authorities. It states that

“ No person shall, within an area subject to the control of a health authority, build or maintain a dam or other construction so as to obstruct the flow of water into or out of a drain under the control of the health authority, nor by any means alter the level of any water so as to reduce its flow, nor construct any steps, bridge or platform over a drain under the control of the health authority without the consent in writing of that health authority; and the health authority may cause any such dam or other construction, or any steps, bridge or platform so built or constructed without written consent to be demolished, altered, re-made or otherwise dealt with, as it may think fit, at the expense of the person building or constructing it, and any money becoming due from a person under this section shall be a civil debt recoverable summarily. ”

Relevance

The proposed NCT will involve impeding drainage on three rivers through weirs with potential of increasing suitable breeding grounds for malaria transmitting mosquitoes. The proponent shall be required to obtain requisite approvals and maintain the drainage system within the project area for removal of water from any land around the project to prevent larvae breeding.

2.3.6 Occupational Safety and Health Act, 2007

Occupational Safety and Health Act (OSHA) is an Act of Parliament that provides for the safety, health and welfare of all workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes.

It applies to all workplaces where any person is at work, whether temporarily or permanently. The purpose of this Act is to:

- Secure the safety, health and welfare of persons at work; and
- Protect persons other than persons at work against safety and health arising out of, or in connection with the activities of persons at work.

OSHA Kenya Gazette Supplement No. 111 (Acts No.15) dated October 26, 2007 revokes the Factories and Other Places of Work Cap.514. The scope of OSHA 2007 has been expanded to cover all workplaces including offices, schools, academic institutions, factories, and plantations. It establishes codes of practices to be approved and issued by the Directorate of Occupational Safety and Health Services (DOSHS) for practical guidance of the various provisions of the Act.

Relevance

The contractor and AWSB will be required to comply with all the provisions of the Act throughout the project cycle.

2.3.7 Work Injury Benefits Act (WIBA), 2007

It is an act of Parliament (No. 13 of 2007) to provide for compensation to workers for injuries suffered in the course of their employment.

It outlines the following:

- Employer's liability for compensation for death or incapacity resulting from accident;
- Compensation in fatal cases;
- Compensation in case of permanent partial incapacity;
- Compensation in case of temporary incapacity;
- Persons entitled to compensation and methods of calculating the earnings;
- No compensation shall be payable under this Act in respect of any incapacity or death resulting from a deliberate self-injury; and
- Notice of an accident, causing injury to a workman, of such a nature as would entitle him for compensation shall be given in the prescribed form to the director.

Relevance

During construction period, the contractor will need to abide by all the provisions of WIBA. Similarly, the same will be required of the proponent during operation phase of the NCT.

2.3.8 The Wildlife Conservation and Management Act, 2013

This Act became operational on 10 January 2014. One of its guiding principles is the devolution of conservation and management of wildlife to landowners and managers in areas where wildlife occurs, through in particular the recognition of wildlife conservation as a form of land-use, better access to benefits from wildlife conservation, and adherence to the principles

of sustainable utilization. Section 25 of the act provides for compensation for injuries and damages caused by wildlife (species listed in its third schedule) to humans and their properties respectively. Such compensation claims are to be reviewed and awarded by County Wildlife Conservation and Compensation Committees at the ruling market rates: provided that no compensation shall be paid where the owner of the livestock, crops or other property failed to take reasonable measures to protect the properties from damage by wildlife or land use practices are incompatible with the ecosystem-based management plan for the area.

The act in its sixth schedule list various animal and tree species that are nationally considered as critically endangered, vulnerable, nearly threatened and protected. It also lists in its seventh schedule, national invasive species for which control is required.

Section 48 restricts activities involving the above listed species without a permit from KWS. KWS can make recommendations to the responsible cabinet secretary, to prohibit carrying out of any activity which: is of a nature that may negatively impact on the survival of species listed in sixth schedule; or is specified in the notice or prohibit the carrying out of such activity without a permit issued by KWS.

Relevance

Any critically endangered, vulnerable, nearly threatened or protected species found within the project area will have to be managed in line with this Act.

2.3.9 The Kenya Roads Board Act, Cap 408 of 1999

This is the main legal instrument that governs management of road network in the country. The act whose commencement date was 01 July 2000 encourages participation of all stakeholders in the road sector during the planning, design, construction and maintenance.

2.3.10 Public Roads and Road of Access Act (Cap 399)

The Act provides for the following with regard to public roads:

- Dedication of line of public travel;
- Application to construct roads of access;
- Notice to be served on land owners affected;
- Granting of leave to construct road of access;
- Notification of order to be registered;
- Right of way over road of Access;
- Power to cancel or alter road of access; and
- Prohibition of classes of traffic

Relevance

Of relevance with the proposed NCT is the need for consultative cooperation with the Constituency Roads Committee before alteration/upgrade of some registered roads, as well as establishment of new project site (intakes and service) access roads. The tunnel will also be below some roads and provisions of the act will be relevant.

2.3.11 The Kenya Roads Act of 2007

The act stipulates the legal and institutional aspects of the road sub-sector policy. The Act provides for the establishment of three independent Road Authorities, namely:

- I. Kenya National Highways Authority (KeNHA), responsible for the administration, control, development and maintenance of all class A, B and C roads in Kenya,
- II. Kenya Rural Roads Authority (KeRRA), responsible for rural and small town roads including class D, E roads and Special Purpose Roads; and
- III. Kenya Urban Roads Authority (KURA) responsible for all City and Municipal Roads.

The Authorities fall under the Ministry responsible for infrastructure, which retains the role of policy formulation, and general oversight of public roads including regulatory aspects such as technical standards.

The proponent will require liaison with these institutions in the improvements existing and development of any new roads within the project area.

2.3.12 Acts Related to Land

(a) The Land Act, 2012

This is an Act of Parliament intended 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. Parts 1 and 2 of section 4 of the Act outline the main guiding principles in land management and administration, binding to all land actors including state officers. These principles are to be applied when Enacting, applying or interpreting any provisions of this Act; and when making or implementing public policy decisions.

The act vests management of land on National Land Commission (NLC). In discharging their functions and exercising of their powers under this Act, the Commission and any State officer or public officer shall be guided by the following values and principles;

- a) Equitable access to land;
- b) Security of land rights;
- c) Sustainable and productive management of land resources;
- d) Transparent and cost effective administration of land;
- e) Conservation and protection of ecologically sensitive areas;
- f) Elimination of gender discrimination in law, customs and practices related to land and property in land;
- g) Encouragement of communities to settle land disputes through recognized local community initiatives;
- h) Participation, accountability and democratic decision making within communities, the public and the Government;
- i) Technical and financial sustainability;
- j) Affording equal opportunities to members of all ethnic groups;
- k) Non-discrimination and protection of the marginalized; and
- l) Democracy, inclusiveness and participation of the people; and
- m) Alternative dispute resolution mechanisms in land dispute handling and management.

Acquisition of Private Land for Public Use

Section 110(1) of the Act provides that land may be acquired compulsorily under this if the Commission certifies, in writing, that the land is required for public purposes or in the public interest as related to and necessary for fulfillment of the stated public purpose.

In such an acquisition, this Act, in section 111(1) provides that just compensation shall be paid promptly in full to all persons whose interests in the land have been determined.

The procedure for land acquisition is laid out in Part VIII of the Act.

Elements for consideration under this procedure include the following:

- The Act requires that the owners, residents and their spouses should also be notified; as opposed to just the owners;

- The inspector would also have to get the consent of the occupier and give them not less than seven days' notice to enter the premises;
- The Commission shall have the power of a court to summon and examine witnesses and compel the production and delivery to the Commission of documents of title to the land;
- Separate award of compensation to every person. An award is final and conclusive evidence of the size of the land, the value in the opinion of the Commission and the amount of compensation payable, whether or not the person attends the inquiry;
- Regulations and rules pertaining to this process are yet to be gazetted;
- Section 107(4) allows for circumstances where the acquiring authority may proceed with land acquisition at stage 1;
- The Commission shall make rules to regulate assessment of just compensation;
- The Act does not explicitly state when the inspection will be done. Whether it is before approval of the request for compulsory acquisition or before serving the notice for acquisition.
- The Commission may post pone an inquiry or adjourn the hearing of an inquiry from time to time for sufficient cause.

Provisions on Acquisition of wayleave

The Land Act, 2012 provides for mechanisms of wayleave acquisition either as public right of way or communal right of way.

Section 143 of the act empowers NLC to create public rights of way. *A public right of way may be: (a) a right of way created for the benefit of the national or county government, a local authority, a public authority or any corporate body to enable all such institutions, organizations, authorities and bodies to carry out their functions, referred to in the Act as a wayleave; or (b) a right of way created for the benefit of the public, referred to in section 145 of this Act as a communal right of way.*

A public right of way shall attach to and run with the servient land in respect of which it has been created and shall be binding on all owners from time to time of the servient land, any manner they are occupying the land, whether under a land or a derivative right thereof, or under customary law or as a successor in title to any such owner or as a trespasser.

Section 144 (1) states that an application, for the creation of a wayleave, shall be made by any State department, or the county government, or public authority or corporate body, to the NLC.

In applying for wayleave, section 144(4) requires the applicant to serve a notice on:

- a) All persons occupying land over which the proposed wayleave is to be created, including persons occupying land in accordance with customary pastoral rights;
- b) The county government in whose area of jurisdiction land over which the proposed wayleave is to be created is located;
- c) All persons in actual occupation of land in an urban and per-urban area over which the proposed wayleave is to be created; and
- d) Any other interested person.

Subsection (5) requires NLC to publish the application along the route of the proposed wayleave calculated to bring the application clearly and in a comprehensible manner to the notice of all persons using land over which the proposed wayleave is likely to be created.

Section 145 (1) provides that a county government, an association, or any group of persons may make an application to the commission for a communal right of way.

Once an application has been made to NLC, the determination for creation of a wayleave is conducted as per section 146 of the act and includes:

- NLC, after at least ninety days from the date of the serving of notices, considering all the information received and all representations and objections made by any person served with a notice and recommending to the Cabinet Secretary whether to:(i) appoint a public inquiry to give further consideration to the representations and objections; or(ii) refer the application to the County Government for its opinion on whether to approve the application; or (iii) initiate and facilitate negotiations between those persons who have made representations on the application and the applicant with a view to reaching a consensus on that application;
- The Cabinet Secretary determining whether or not to create a public right of way, after taking account, as the case may be, of:(a) the recommendations of the Commission; or(b) the advice of the county government; or (c) the outcome of any negotiations referred to above;
- The Cabinet Secretary creating a public right of way by order in the Gazette. The order comes into force thirty days after its publication in the gazette.

An appeal against an order creating the wayleave is allowed within six weeks after the order has been made. Such appeal is made to the Court on a point of law against an order made by the Cabinet Secretary, but apart from such an appeal, an order of the Cabinet Secretary shall not be questioned by way of judicial review or otherwise in any court.

According to section 148, prompt compensation shall be payable (by the State Department, county government, public authority or corporate body that applied for the public right of way) to any person for the use of land, of which the person is in lawful or actual occupation, as a communal right of way and, with respect to a wayleave, in addition to any compensation for the use of land for any damage suffered in respect of trees crops and buildings as shall, in cases of private land, be based on the value of the land as determined by a qualified valuer.

In case of disagreement or dissatisfaction on amount or method of or time taken to make payment, the affected individual may apply to court for determination and award.

Section 148 (6) stipulates that NLC shall make regulations prescribing the criteria to be applied in the payment of compensation. However, these regulations have not yet been formulated.

(b) The National Land Commissions Act, 2012

This is an Act of Parliament to make further provision as to the functions and powers of the National Land Commission, qualifications and procedures for appointments to the commission; to give effect to the objects and principles of devolved government in land management and administration, and for connected purposes.

The mandate of the Commission, as provided for in the Act, Pursuant to Article 67(2) of the Constitution, shall be:

- To manage public land on behalf of the national and county governments;
- To recommend a national land policy to the national government;
- To advise the national government on a comprehensive programme for the registration of Title in land throughout Kenya;
- To conduct research related to land and the use of natural resources, and make recommendations to appropriate authorities;
- To initiate investigations, on its own initiative or on a complaint, into present or historical land injustices, and recommend appropriate redress;

- To encourage the application of traditional dispute resolution mechanisms in land conflicts;
- To assess tax on land and premiums on immovable property in any area designated by law; and
- To monitor and have oversight responsibilities over land use planning throughout the country
- On behalf of, and with the consent of the national and county governments, alienate public land;
- To monitor the registration of all rights and interests in land;
- To ensure that public land and land under the management of designated state agencies are sustainably managed for their intended purpose and for future generations;
- Develop and maintain an effective land information management system at national and county levels;
- Manage and administer all unregistered trust land and unregistered community land on behalf of the county government; and
- Develop and encourage alternative dispute resolution mechanisms in land dispute handling and management.

This Commission will be integral in the management of land issues arising from the project implementation, especially as far as portals and pipelines wayleave acquisition is concerned.

(c) The Land Registration Act, Act No. 3 of 2012

This is an Act of Parliament intended to revise, consolidate and rationalize the registration of titles to land, to give effect to the principles and objects of devolved government in land registration, and for connected purposes.

Land Registry

Section 7(1) of the Act provides for establishment of a land registry in each registration unit which shall keep registers of the following regarding land:

- A land register, in the form to be determined by the Commission;
- The cadastral map;
- Parcel files containing the instruments and documents that support subsisting entries in the land register.
- Any plans which shall, after a date appointed by the Commission, be geo-referenced;
- The presentation book, in which shall be kept a record of all applications numbered consecutively in the order in which they are presented to the registry;
- An index, in alphabetical order, of the names of the proprietors; and
- A register and a file of powers of attorney.

Maintenance of documents, including land title deeds

Further, section 9(1) provides that the Registrar shall maintain the register and any document required to be kept under this Act in a secure, accessible and reliable format. These documents include

- Publications, or any matter written, expressed, or inscribed on any substance by means of letters, figures or marks, or by more than one of those means, that may be used for the purpose of recording that matter;
- Electronic files; and
- An integrated land resource registers.

The register, as provided for in part 2 of section 9, shall contain the following particulars;

- Name, personal identification number, national identity card number, and address of the proprietor;
- In the case of a body corporate, name, postal and physical address, certified copy of certificate of incorporation, personal identification numbers and passport size photographs of persons authorized and where necessary attesting the affixing of the common seal;
- Names and addresses of the previous proprietors;
- Size, location, user and reference number of the parcel; and
- Any other particulars as the Registrar may, from time to time, determine.

These provisions are essential to any new land acquisition or transaction processes arising from implementation of the NCT project.

(d) The Land and Environment Court Act, 2012

This is an Act of Parliament to give effect to Article 162(2) (b) of the Constitution; to establish a superior court to hear and determine disputes relating to the environment and the use and occupation of, and title to, land, and to make provision for its jurisdiction functions and powers, and for connected purposes. The principal objective of this Act is to enable the Court to facilitate the just, expeditious, proportionate and accessible resolution of disputes governed by this Act.

Section 13 (2) (b) of the Act outlines that in exercise of its jurisdiction under Article 162 (2) (b) of the Constitution, the Court shall have power to hear and determine disputes relating to environment and land, including disputes:

- Relating to environmental planning and protection, trade, climate issues, land use planning, title, tenure, boundaries, rates, rents, valuations, mining, minerals and other natural resources;
- Relating to compulsory acquisition of land;
- Relating to land administration and management;
- Relating to public, private and community land and contracts, leases, mortgages, charges, easements, covenants, or other instruments granting any enforceable interests in land; and
- Any other dispute relating to environment and land.

Section 24 (2) also states that the Chief Justice shall make rules to regulate the practice and procedure, in tribunals and subordinate courts, for matters relating to land and environment.

Section 30 (1) states that all proceedings relating to the environment or to the use and occupation and title to land pending before any Court or local tribunal of competent jurisdiction shall continue to be heard and determined by the same court until the Environment and Land Court established under this Act comes into operation or as may be directed by the Chief Justice or the Chief Registrar.

Any land or/and environmental cases arising from the project will be handled in accordance with the provisions of this act.

2.3.13 The Physical Planning Act, 1996

The Act provides for the preparation and implementation of physical development plans and for connected purposes. It defined development, in section 3(a), as the making of any material change in the use or density of any buildings or land or the subdivision of any land which for the purposes of this Act classified as Class A development. Class A development constitutes deposition of refuse, scrap or waste materials on land, erection of dwellings and display of advertisements.

- In order to promote health, safety, order, amenity, convenience and general welfare of all its inhabitants as well as efficiency and economy in the process of development and improvement of communications, the Act provides that every local authority must have a physical development plan as.
- *“...The basis for disposing of land acquired, or to be acquired under the plan by a local authority or relevant authority;*
- **Section 4:** *The re-planning and reconstruction of the plan area, or any part thereof, including any provisions necessary for.....*
- **Section 4 (e):** *Effecting such exchanges of land or cancellation of existing sub-divisions as may be necessary or convenient for purposes mentioned above in this paragraph*
- **Section 4 (f):** *Adjustment of rights between owners or other persons interested in such lands, roads, streets or right of way.....”*

Section 29 of the Act vests powers in the local authorities to control development in their respective areas of jurisdiction, with legal mandate to vet development applications and approval or disapproval thereof.

In section 30, the legislation declares that any person intending to carry out development within a local authority is required to apply for development permission, forwarded to the clerk of the local authority. Until such permission is granted, no development activity shall be carried out by the proponent.

Relevance

The NCT project is likely to have a variety of additives, construction of storage, processing and housing and sanitation structures just but a few. For each development case, the stipulated procedure laid down by this Act shall be complied with before the activities begin.

It is however notable that this act is under review to align it with the new constitution. Some of its provisions like the local authorities are no longer applicable having been abolished in the new constitution.

2.3.14 Mining Act, Cap 306

Section 4 of the Mining Act vests all unextracted minerals (other than common minerals) under or upon any land in the Government, subject to any rights in respect thereof which, by or under this Act or any other written law, have been or are granted, or recognized as being vested, in any other person.

Section 25 state that when a holder of any exclusive prospecting licence or location discovers on any land comprised in such licence or location any minerals of economic value other than those for which the licence was granted or location was registered, he shall immediately report the discovery thereof to the Commissioner of Mines and Geology.

Mining (Safety) Regulations

These regulations provide guidelines to ensure safety and prevent danger to workers or others persons at mining areas including where works are undertaken underground.

Where necessary, among others it requires the following:

- The mouth of every shaft, winze or pit and the entrance to every underground working, whether above or below ground to be fenced;
- All parts of every underground working shall be properly and sufficiently ventilated to the satisfaction of an inspector of mines;
- Disused workings to be examined before being used. Underground workings, especially shafts, sumps and winzes, which have been in disuse for some time shall be tested with a candle flame by a party of not less than three persons before being used again, in order to ascertain whether or not foul air or other dangerous gases have accumulated there; until such places are fit to work in they shall be fenced or otherwise made inaccessible and no person shall be allowed to enter;

- Provision of sufficient and suitable sanitary conveniences, regard being had to the number of persons employed in the mine for both on the surface, and also in underground workings. Wooden conveniences underground prohibited;
- First aid requirements;
- Procedures in case of accidents;
- Provides for safe means of handling machinery underground;
- Safe ways of transporting materials underground.

Relevance

NCT will entail underground tunnelling works and reference to these regulations will be essential in ensuring safety on site. Since the contractor will have no mining rights and any chance find of economic minerals shall be reported to commissioner of mines in line with this Act.

2.3.15 Explosives Act, Cap 115

This is an Act of Parliament that regulates the manufacture, storage, sale, transport, importation, exportation and use of explosives. Some of the key provisions of this act relevant to the project include:

- *Section 8(1)*: No person, other than the manufacturer, shall sell, deal in or dispose of any explosive unless he is in possession of a license granted under this Act;
- *Section 9(1)*: No person shall purchase or otherwise acquire blasting materials except under the authority of, and to the extent authorized in, a written permit issued by an inspector.
- *Section 11 (1)*: No person shall use, or cause to be used, any blasting materials at a depth of ten meters or more, measured from the surface along or down a shaft, adit, well or tunnel, unless he is in possession of a valid miner's blasting certificate issued to him under the Mining Act, or is under the immediate supervision of the holder of such a certificate; and
- *Section 13(1)*: No person shall convey explosives or cause them to be conveyed within Kenya, except under and in accordance with a permit in writing issued by an inspector

Explosives (Blasting Explosives) rules

These rules provide detailed requirements for ensuring safe packaging, licensing and construction of magazines, storage and reporting accidents related to handling explosives.

Relevance

Use of explosives during tunnel construction is envisaged in the project design and the proposed explosives are gelatine and ammonium nitrate. The contractor engaged will have to abide by all relevant provisions of this act and its rules. All licences required for handling, transporting, storage and use of the explosives must be obtained and remain valid throughout the construction period.

2.3.16 The Penal Code (Cap. 63)

Section 191 of the Penal Code makes it an offence for any person or institution that voluntarily corrupts, or foils water for public springs or reservoirs rendering it less fit for its ordinary use. Similarly, section 192 prohibits making the atmosphere in any place noxious to health of persons/institution in dwellings or business premises in the neighbourhood or those passing along a public way.

Relevance

The contractor and proponent will be required to ensure strict adherence to the Environmental Management Plan throughout the project cycle in order to mitigate any possible negative impact associated with dust, noise, and effluent discharge.

2.4 World Bank Safeguard policies

2.4.1 World Bank policy OP 4.01 Environmental Assessment

World Bank requires environmental assessment for projects proposed for the Bank financing to help ensure that they are environmentally sound and sustainable, and thus improve on decision making. Projects are screened and assigned categories (A, B, C or FI) depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.

Following screening of the Main project, *Water and Sanitation Service Improvement Project - Additional Financing*, this project was classified as category A, requiring a full Environmental Assessment (EA). This is because the environmental and social impacts of NCT component were anticipated to be significant.

Based on the review of the major constraints and opportunities facing sustainable development in Africa, and taking into account, key principles underlying environmental sustainability and the overall objectives of the Policy, a number of key environmental issues have been identified. WB's policy principles relevant to the project include:

- Environmental sustainability of project activities;
- Application of environmental assessment;
- Potential adverse impact on biodiversity;
- Improving Urban Environmental Management;
- Institution and Capacity Building;
- Increasing Awareness; and
- Stakeholder Participation.

Relevance

Implementation of NCT is required to take place within WB policy framework on the best practices when it comes to ensuring that the project does not destabilize the riverine aquatic ecosystem, affect downstream users or degrade the environment.

2.4.2 World Bank policy OP 4.04 Natural Habitats

The WB recognises that conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank supports, and expects borrowers to apply, a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development.

Relevance

Although the natural terrestrial vegetation cover in the project area has been significantly altered, NCT will occur on natural rivers dominated by native species. Precaution is thus required in line with OP 4.04 to ensure the riverine resources management are sustainable.

2.4.3 World Bank policy OP 4.11 Physical Cultural Resources

OP 4.11 on Physical Cultural Resources, was revised on April 2013 to takes into account the recommendations in *Investment Lending Reform: Modernizing and Consolidating Operational Policies and Procedures*, Given that some cultural resources may not be known or visible, it is important that a project's potential impacts on cultural resources are considered at the earliest possible stages of project processing.

The assessment of impacts to cultural heritage has been based on identified aboveground features and known sites of archaeological interest, this is because, there is no archaeological cultural and settlement inventory covering the project area throughout the history of human occupation. However, as the policy requires, precaution is necessary in case of chance find.

Relevance

The contractor and AWSB will be required to follow chance find Procedures and contact the National Museums of Kenya (NMK) should any archeological site or artifact encountered during construction.

2.4.4 World Bank Operational Policy 4:12 Involuntary Resettlement

The World Bank safeguard policy on involuntary resettlement, Operational Policy (OP 4.12) establishes guidelines for land acquisition and compensation of people affected by a world bank sponsored project. Key principles and policy objectives of OP 4:12 can be summarised as:

- To minimise or avoid involuntary resettlement where feasible and to explore all viable alternative project designs;
- To conceive and implement resettlement activities as sustainable development programs where affected people are provided with sufficient investment resources and opportunities to share in project benefits;

Relevance

The project triggers this policy as there were areas where there was no possible project alternative. A RAP study has been carried out to provide guidance on land acquisition and compensation to the affected persons.

The above policy principles have been applied through consulting affected persons and according them opportunities to participate in the planning and execution of resettlement programs. This will assist the Project affected persons (PAPs) where resettlement is necessary, to improve their livelihood and living standards, income earning capacity and production levels, or at least to restore them in a manner that maintains sustainability of resettlement programs. The RAP report has been publicly disclosed in Kenya and in the World Bank InfoShop.

The Compensation framework shall be based on:

- For agricultural land, land of equal productive use or potential, prepared to a similar level and located in the vicinity of the affected land;
- For residential land, land of equal size and use, with similar infrastructure and services and located in the vicinity of affected land;
- For structures, full replacement cost to purchase or build new structures of a similar size and quality to affected houses and other affected structures; and
- Subsidies to assist AP with costs associated with the transition period in the resettlement site e.g., moving costs, living allowance, business losses lost production etc.

2.4.5 World Bank Operational Policy 4:37 Safety of Dams

This OP provides guidelines to ensure safety at Bank financed projects involving dams. Safety measures require appropriate plans for:

- Construction supervision and quality assurance;
- Instrumentation plan;
- Operation and Maintenance (O&M) plan; and
- Emergency preparedness plan.

In the case of existing dams, any dam that can influence the performance of a project must be identified and its safety assessed. Necessary dam safety measures or remedial work are implemented. According to the OP, Dams over 15 meters in height are classified as large dams. High hazard dams are those under 15 metres but which are in a zone of high seismicity and /or where foundations and other design features are complex.

Relevance

The NCT1 will on commissioning direct its waters into an existing Thika Dam hence triggering this OP. AWSB will review and update the dam safety and emergency preparedness plan if necessary.

2.5 AFD Policy on Environmental and Social Risk Management

2.5.1 Policy

The environmental and social risk management process (including risks related to climate change) for the operations financed by AfD applies throughout the project life cycle. This risk management mechanism meets the objectives of harmonizing the environmental and social procedures of Official Development Assistance agencies set out in the Paris Declaration on Aid Effectiveness.

2.5.2 Environmental and Social Risks

The policy recognizes that projects can have risks in terms of ecology (adverse effect on natural environments and biodiversity), pollution (water, air, soil) and nuisances (noise, waste...) and natural, technological and health risks. They can also have an impact on the health and safety of communities, natural resources (water resources, soil and underground resources, land resources), on the living conditions of communities, and on the natural, historical and/or cultural heritage. The social risks mainly concern the respect of fundamental human rights for which there are recognized international standards, laws and conventions: human traffic, sex tourism, population displacement, forced labor, working conditions, equity for disadvantaged or excluded social groups (particularly women), non-respect of cultural diversity, adverse effects on the environment, etc.

2.5.3 Reference Standards

All operations financed by AFD Group are required to comply with the national regulations of the country where the operation is implemented, including for environmental and social issues. However, as regulations in the countries where AFD Group operates are sometimes incomplete or being developed, AFD Group uses a number of rules, good practices and directives produced by international standard-setting organizations as a reference.

This mainly concerns:

- The UN Principles for Responsible Investment (UNPRI);
- The World Bank Safeguard Policies for public sector financing;
- The IFC Performance Standards for private sector financing. These standards are applied by Proparco for high-risk projects (A and B+); and
- The “Principles for Responsible Financing”. They are used by all European Development Finance Institutions (EDFI Group) and are applied by Proparco.

The major international conventions ratified by the countries where AFD operates are also used as references, mainly:

- The United Nations Universal Declaration on Human Rights;
- The ILO fundamental conventions on labor law;
- The United Nations Convention on the Elimination of All Forms of Discrimination

- against Women; and
- The OECD guidelines.

AFD promotes inclusion of environmental and social (E&S) clauses in the contracts for goods and services financed by Official Development Assistance to promote a level playing field for international competitive bidding and improve the overall level of E&S requirements.

Relevance

The NCT1 will have to comply with the Kenyan environmental laws (reviewed in section 2.3) as required by this policy and the anticipated risks from its implementation have been assessed based on the relevant World Bank environmental and social safeguards. Kenya has also ratified majority of the international conventions recognised by AFD above e.g. on human rights, Labor laws and the elimination of all forms of discrimination against women and the project is expected to meet their requirements. AWSB shall also include E&S clauses in the NCT1 contract to impose on the project's contractor E&S performance.

2.6 Institutional Framework

The following are the main institutions that perform regulatory roles and are relevant to the Project.

2.6.1 Ministry of Environment, Water and Natural Resources

The mandate of the Ministry is to protect, conserve and manage the environment and natural resources of Kenya sustainably with a view of supporting socio-economic development, reduce poverty, improve living standards and ensure a clean environment.

The Ministry's Water Sector has its fundamental goal and purpose as conserving, managing and protecting water resources for socio-economic development. Its aim is to improve the living standards of people by ensuring proper access to available water resources.

Relevance

Water resources, land, flora and fauna and the air are core components of the natural environment. The proposed development project will utilize surface water and all the other resources at one stage or another. Any extractive or depository uses of the resources are guided by the various programmes and regulations under the ministry and consistent consultative partnerships, including adherence to relevant legal provisions will be required in the entire course of the project.

2.6.2 Athi Water Services Board

Athi Water Services Board (AWSB) is the project implementing agency. AWSB is one of the eight Water Boards under the Ministry of Environment, Water and Natural Resources created under Section 51 of the Water Act 2002 to bring about efficiency, economy and sustainability in the provision of water and sewerage services in Kenya.

Core mandates of AWSB include:

- Plans and develops National Public Water Works for bulk water supply;
- Formulates Development and Investment Plans in liaison with county governments;
- Provides input to the national development and financing plan; and
- Provides technical assistance to Water Service Providers for county asset development

AWSB is serving a population of over 4.5 million in Nairobi City County and some of its satellite towns.

2.6.3 Nairobi City Water and Sewerage Company (NCWSC)

NCWSC is a Water Service Provider formed in line with the water act of 2012 and is charged with the provision of the water and sewerage services in Nairobi. NCWSC has been appointed by the Athi Water Service Board to provide water and sewerage services to the residents of Nairobi and its environs.

NCWSC will be responsible for operation and maintenance (O&M) of the project once commissioned.

2.6.4 The National Environment Management Authority (NEMA)

The responsibility of NEMA is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment.

Some of the NEMA functions are performed through committees established by EMCA as follows.

(a) Standards and Enforcement Review Committee (SERC)

EMCA provides for the establishment and enforcement of environmental quality standards to be set by a technical committee of NEMA known as the Standards and Enforcement Review Committee (SERC).

(b) Public Complaints Committee

EMCA has also established a Public Complaints Committee, which provides the administrative mechanism for addressing environmental harm. The Committee has the mandate to investigate complaints relating to environmental damage and degradation. The members of the Public Complaints Committee include representatives from the Law Society of Kenya, NGOs and the business community.

(c) County Environmental Offices

NEMA has offices at county levels contributing to decentralised environmental management.

Relevance

The project will have to be licensed by NEMA before construction starts and during operation NEMA will have overall supervision of environmental matters.

2.6.5 Water Resource Management Authority (WRMA)

The water Resource Management Authority is a national organization with the mandate of regulation of water resources issues such as water allocation, source protection and conservation, water quality management and pollution control and international waters. The services provided by WRMA include:

- Planning, management, protection and conservation of water resources.
- Planning, allocations, apportionment assessment and monitoring of water resources.
- Issuance of water permits.
- Water rights and enforcement of permit conditions.
- Regulation of conservation and abstraction structures.
- Regulation and control of water use.
- Coordination of the Water resources management plan.

WRMA sub-regional office at Murang'a and regional office at Embu will be responsible for issuance of water rights and enforcement of any conditions attached.

2.6.6 Water Services Regulatory Board

Water Services Regulatory Board (WSRB) regulates the provision of services by registered Water Services Providers (WSP) through the Water Services Boards (WSB). WSBs have been created for the various regional drainage basins in the country. The proposed NCT1 will be under the jurisdiction of Athi Water Services Board but involving transfer of water from a basin under the jurisdiction of Tana Water Services Board.

2.6.7 Ministry of Agriculture, Livestock and Fisheries

The overall function of the ministry is to enhance production of crops, livestock and fisheries, marketing and processing. The Ministry has also the mandate to provide development and extension services to smallholder farmers through its extension department.

The functions of the ministry are as follows:

- Formulate, implement and monitor legislations, regulations and policies;
- Provide extension services;
- Support research and promote technology delivery;
- Facilitate and represent agricultural state corporations in the government;
- Develop, implement and coordinate programmes in the agricultural sector;
- Regulation and quality control of inputs, produce and products from the agricultural sector;
- Management and control of pests and diseases;
- Promote management and conservation of the natural resource base for agriculture; and
- Collect, maintain and manage information on the agricultural sector.

Relevance

The project area is a tea farming zone with potential for development of other crops under both rain fed and irrigation agriculture. Agricultural practices within the project area will require strict management to conserve its natural resources without harming its water production potentials. Any future irrigation development in the project area is likely to have implications on future water balance and hence sustainability of the project among other heavy water-reliant activities.

2.6.8 Kenya Forest Service

Kenya Forest Service (KFS) is mandated to manage protected forests within the country. Protection of the Aberdare forest will be vital for sustained water supply for the project targeted Rivers.

2.6.9 Kenya Wildlife Service

Kenya Wildlife Service (KWS) is principal institution responsible for implementation of the Wildlife Management Act, 2013. KWS is responsible for protection of all wildlife within the Aberdare forest reserve and thus works jointly with KFS in the forest conservation management program.

2.6.10 Directorate of Occupational Safety and Health

Directorate of Occupational Safety and Health (DOSHS) is a government agency responsible for enforcement of Occupational Safety and Health throughout the country for the protection of workers and the general public at all work places in line with OSHA, 2007.

2.6.11 County Government of Murang'a

Murang'a County is the project host county will have various inputs in the project implementation in line with constitutional functions of county governments. The functions of the county government relevant to the proposed project, as outlined in the Fourth Schedule, Constitution of Kenya 2010 are as follows:

- Agriculture and husbandry;
- Provision of essential services such health services, county transport, education;
- Control pollution and disasters management;
- Monitor cultural activities, public entertainment and public amenities;
- County planning and development;
- County public works and services;
- Implementation of specific national government policies on natural resources and environmental conservation; and
- Encourage public participation in county governance and development

The county government of Murang'a is thus expected to help in coordinating various project related activities as far as general environmental conservation and public participation are concerned. This will be better achieved through the county ministry of Ministry of Environment, Water and Natural Resources.

2.7 International Conventions

2.7.1 Convention on Biological Diversity

This global convention was held to foster conservation and sustainable use of biological resources, to preserve their diversity for posterity. Kenya is a signatory to this convention, having ratified it in 1994. The provisions of this Convention have since been integrated in the laws of Kenya, climaxed by the development of the Kenya National Biodiversity Strategy and Action Plan in 2000 by the Ministry of Environment and Natural Resources.

Relevance

In line with the spirit of the convention, there is need to integrate biodiversity in water resource planning as the environment has been considered a legitimate user of water thus the project shall consider the volume of water abstracted leaves enough water for the existent ecosystems.

2.7.2 The Ramsar Convention

This is the Convention on Wetlands of International Importance. It was held in Ramsar, in 1971 and came into force in 1975, hence the name Ramsar Convention. The aim of this convention was to raise to global context the value of wetlands in our ecosystem and encourage partner states to develop instruments for conservation and management of wetlands. Kenya ratified the convention in June 1990.

The convention defines "Wise use of wetlands" as "the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development". "Wise use" therefore has at its heart the conservation and sustainable use of wetlands and their resources, for the benefit of humankind.

Under the "three pillars" of the Convention, the Parties have committed themselves to:

- Work towards the wise use of all their wetlands through national land-use planning, appropriate policies and legislation, management actions, and public education;

- Designate suitable wetlands for the List of Wetlands of International Importance ("Ramsar List") and ensure their effective management; and
- Cooperate internationally concerning transboundary wetlands, shared wetland systems, shared species, and development projects that may affect wetlands.

Relevance

There is no designated Ramsar site within the project area. However, to avoid detrimental effects of water abstraction, hydrological survey has been done to ensure that the development of NCT1 is sustainable by abstracting water in quantities that will have minimal effect on water uses downstream.

2.7.3 African Convention on the Conservation of Nature and Natural Resources

It was held on 15 September, 1968 in Algiers. The convention sought to awaken the continent on the need to preserve natural ecosystems and employ sustainable use of natural resources of economic importance, particularly the soil, water, flora and fauna.

Relevance

Some indigenous trees exist within the project area whose conservation are important. The project shall encourage the planting of indigenous trees to try to restore a balance within the ecosystem.

2.7.4 Kyoto Protocol to the United Nations Framework Convention on Climate Change

The Kyoto Protocol requires signatories to the United Nations Framework Convention on Climate Change to reduce their green house emissions levels to 5% below 1990 levels by the year 2012. The Protocol came into force on 16th February 2005, after it received the pre-requisite signatures. However, major countries like United States, China, India, and Australia are not signatories to the Protocol.

Relevance

Compliance with this convention will largely inform the technical and environmental evaluation of the project if any additional funding may be required in future. There is thus a necessity that proper adherence to minimal carbon emission levels be ensured during the operational phases of the project.

2.7.5 The 1992 United Nations Framework Convention on Climate Change (UNFCCC);

The primary purpose of the convention is to establish methods to minimize global warming and in particular the emission of the greenhouse gases. The UNFCCC was adopted on 9th May 1992 and came into force on 21st March 1994. The Convention has been ratified by 189 states. Kenya ratified the Convention on 30th August 1994.

The project implementation will most certainly be accompanied by use of a variety of hydrocarbon based fuels and other chemical substances. Some of the gases or compounds resulting from consistent use of these substances are real ozone layer threat. The result is increase greenhouse gas emission into the atmosphere. There will thus be need to employ domesticated versions of the agreed carbon-curbng measures to protect the ozone layer from further depletion.

2.7.6 Vienna Convention for the Protection of the Ozone Layer

Intergovernmental negotiations for an international agreement to phase out ozone depleting substances concluded in March 1985 with the adoption of the Vienna Convention for the Protection of the Ozone Layer. This Convention encourages intergovernmental cooperation on research, systematic observation of the ozone layer, monitoring of CFC production, and the exchange of information.

The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in September 1987, and was intended to allow the revision of phase out schedules on the basis of periodic scientific and technological assessments. The Protocol was adjusted to accelerate the phase out schedules. It has since been amended to introduce other kinds of control measures and to add new controlled substances to the list.

3 BASELINE ENVIRONMENTAL SETTING

3.1 Physical environment

3.1.1 Climate

The climatic conditions of both Kangema and Kigumo sub-counties are similar as they are influenced by the Aberdare Ranges. The project area experiences an equatorial type of climate and tropical weather dominated by seasonal monsoons. This climatic condition corresponds to agro-ecological zones 1 and 2 (high potential).

(a) Rainfall

The seasonal distribution of rainfall is dominated by the movement of the Inter Tropical Convergence Zone (ITCZ) which separates the North eastern and south eastern trade wind systems and the belt of maximum rainfall follows the position of the overhead sun with a time lag of about 4 to 6 weeks. The area has two rainy seasons: April-May (long rains); and October-November (short rains). During the intervening dry seasons monsoonal systems bring rather dry air masses. From December to March the persistent North easterly monsoon brings clear sunny weather with only occasional showers. During the period of South easterly monsoon from June to October the weather is duller and cooler with occasional drizzle which is more persistent at higher elevations.

The highest annual rainfall totals of over 2,600 mm occur on the windward side of the summit of the Aberdares. The areas receive an average annual rainfall of between 1400mm and 1600mm. The rainfall is reliable and well distributed throughout the year and is adequate for cultivation as well as rearing livestock.

Mean monthly rainfall at the project area is presented in Figure 3-1 below.

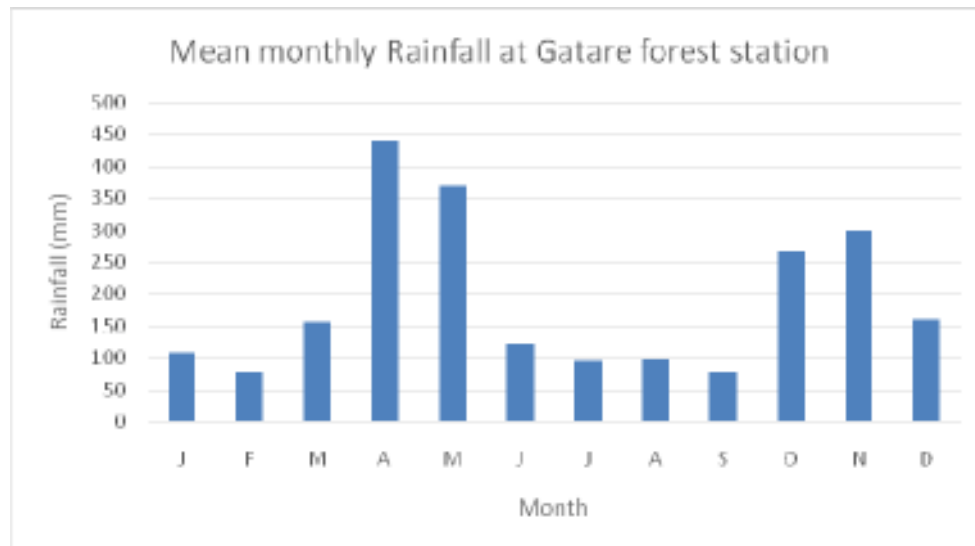


Figure 3-1: Mean monthly rainfall at Gatare forest station

There are many rainfall stations around the study area, but The Gatare Forest rainfall station was selected and used to demonstrate the rainfall patterns in the project, due to its central location within the project area and availability of consistent and long term data.

(b) Temperature and humidity

The maximum annual temperature range between 26 and 30 degrees Celsius while the mean minimum annual temperature range between 14 and 18 degrees Celsius. In the colder areas, the mean minimum annual temperatures can be as low as 6 degrees Celsius or less.

Mean annual relative humidity values range from 65% at lower elevations to 80% or more above 2,500 metres. Humidity is greatest at dawn and lowest in the early afternoon when the temperature reaches the diurnal maximum.

The average monthly humidity ranges between 45% and 60% during the evening and between 60% and 90% in the morning.

(c) Sunshine hours

Below 1,500 metres the mean daily duration of bright sunshine ranges from 4 hours during July and August to 9 hours during the Northern Monsoon season with an annual mean of 6.8 hours. Sunshine decreases with altitude, with an annual mean of 5 hours at 2,500 metres.

(d) Evaporation

Mean annual free water surface evaporation as calculated by Woodhead ranges from around 1,800 mm in the piedmont zone to less than 1,400 mm in the Aberdare Ranges. Potential evapotranspiration is estimated to be about 75% of free water evaporation in the highlands and 80% or more in dryer areas.

(e) Winds

The wind run measured at Thika and Kimatia shows average monthly values between 35 and 110 miles per day (7.38 Km/hr). Generally, the greatest amount of wind occurs in the dry season, January to February, whilst June to August is calmer.

3.1.2 Topography and Drainage

The land in the project area generally rises gradually from east to west culminating at the slopes of Aberdare Ranges. The Aberdare Ranges highly influences the landscape around the proposed project area. The topography is rugged and the soils are deep making the area favourable for tea growing. The highest land occurs in the Aberdare Mountain Range where elevations of over 3,500 metres are reached within the study area. The Aberdare forest is one of the country's five water towers and the source of several rivers which include the Maragua, Irati and Gikigie Rivers flowing eastwards to join the Tana River.

There is generally a thick mantle of weathered rock and soil and bedrock is rarely exposed except within the river channels. This weathered mantle and the forest vegetation which covers elevations above 2,200 metres dampen the flood response of the rivers to intense rainfall and also sustain dry weather flows. The rivers emerge from these incised valleys onto a flat piedmont zone at an elevation of approximately 1500 metres, without significant perennial tributaries, and join the main Tana River.

The topography in project area is both an asset and liability to development. The terrain is dissected creating the risks of landslides and gully erosion. The numerous streams and gulleys necessitate the construction of numerous bridges to connect one ridge to the other making the construction and maintenance of roads in the area difficult and expensive.

3.1.3 Geology

The dominant geological formation on the eastern slopes of the Aberdares, east of Nyandarua Peak is the Simbara Series. This formation consists of basalts and agglomerates. It is the basal volcanic flow and thus is the most likely to be encountered during boring operations. The Simbara Series is overlain by the Laikipian lavas or pyroclastic rocks; both occur in isolated patches in the area to be traversed by the tunnel.

The geological sequences of relevance to the project are the Simbara Series and the Laikipia Lavas and associated Pyroclastic Rocks which occur along the tunnel alignment (as indicated in Figure 3-1):

- Simbara Series** comprises basalts, basaltic agglomerates and auto-breccias. These rocks are relatively young, Miocene Age (5 – 20 Ma), and associated with the recent east African rifting. The Simbara series forms the relief topography of the area, and is locally expected to dip at 2 degrees towards the south east. These basalts comprise augite, olivine, plagioclase and feldspar. The rock would thus be dark (grey) and where feldspar contents increase the rock becomes lighter coloured, and where feldspar insets are arranged concentrically around vesicles the rock has appearance of “chopped straw”.

Numerous generally east trending, highly fractured, basaltic narrow (<10m) “dyke-like” intrusions are associated with this series but have only been observed outcropping to the west of the project near the Aberdare Mountains. Locally, if they do occur, they would not be easy to observe due to thick soil cover and vegetation. The simbara series basalt dominates the Ichichi, Gikigie and Kinyona areas.

- Laikipia Lava and Pyroclastic Rocks** comprises pyroclastic rocks (with a range of clast sizes from the largest agglomerates>65mm, lapilli<65mm, to tuffs<2mm and very fine ashes), with intercalated Laikipian-type basalt. These are young rocks deposited within the last 2- 5Ma, Middle Pleistone to Pliocene Age (the period associated with early humanoids). These were deposited into the very uneven, eroded and dissected landscape on the Simbara Series.

A feature of the Laikipia Lavas rocks are their non-porphyrific structure, they are a fine grained dark basaltic rock with a hackley fracture.

Soft, light-coloured tuffs are the most common pyroclastic rock, and often fill hollows in eroded basaltic agglomerates, many varieties containing pumice, or being described as trachytic pumice tuffs. The pyroclastics mainly outcrop in Makomboki valley.

- Other recent pyroclastic rocks and sediments may in places overlie the above series but are not indicated on the mapping.
- The Sattima fault is discussed as the major fault in the area, occurring some 15km to the west of the project area trending north-south.

From the design review report five rock types are distinguished. A table summarising the occurrence of rock is given below.

Table 3-1: Percentage occurrence of rock grades, in boreholes and along tunnel alignment

| Rock type | Description/Comment |
|------------------------|---|
| Basalt (vesicular) | this would largely be of the Simbara Series |
| Basalt (non-vesicular) | this would presumably be mostly Laikipia Lavas |
| Agglomerate | this would be either of the Simbara Series or a recent pyroclastic deposits |
| Lapilli tuff | mostly of recent pyroclastic deposits |
| Clay/ topsoil | Residual soils and completely weathered rock |

Due to the limited extent of information available, the rock types were reduced to 3 with upper, intermediate and lower bound conditions (rock class designations), as appropriate, as described in Tables 3-2 below. The geological map of the project area is presented in Figure 3-2 and the geological section along the tunnel route is presented in Figure 3-3.

Table 3-2: Rock Units

| Rock type | Description/Comment |
|--------------------------------------|---|
| Basalt (vesicular and non-vesicular) | This would combine lava flows of the Simbara Series and mostly Laikipia Lavas. The rock would generally be described as fresh and hard in the upper bound state (BUB) or highly weathered soft rock in the lower bound (BLB) state. An intermediate state of hard but highly fractured rock (BIF) is also recognised. |
| Agglomerate and Lapilli tuff | This would be either of the Simbara Series or recent pyroclastic deposits. The rock would generally be described as soft and largely intact in the upper bound (AUB) and highly fractured in the lower bound state (ALB). |
| Clay/ topsoil | Residual soils and completely weathered rock |

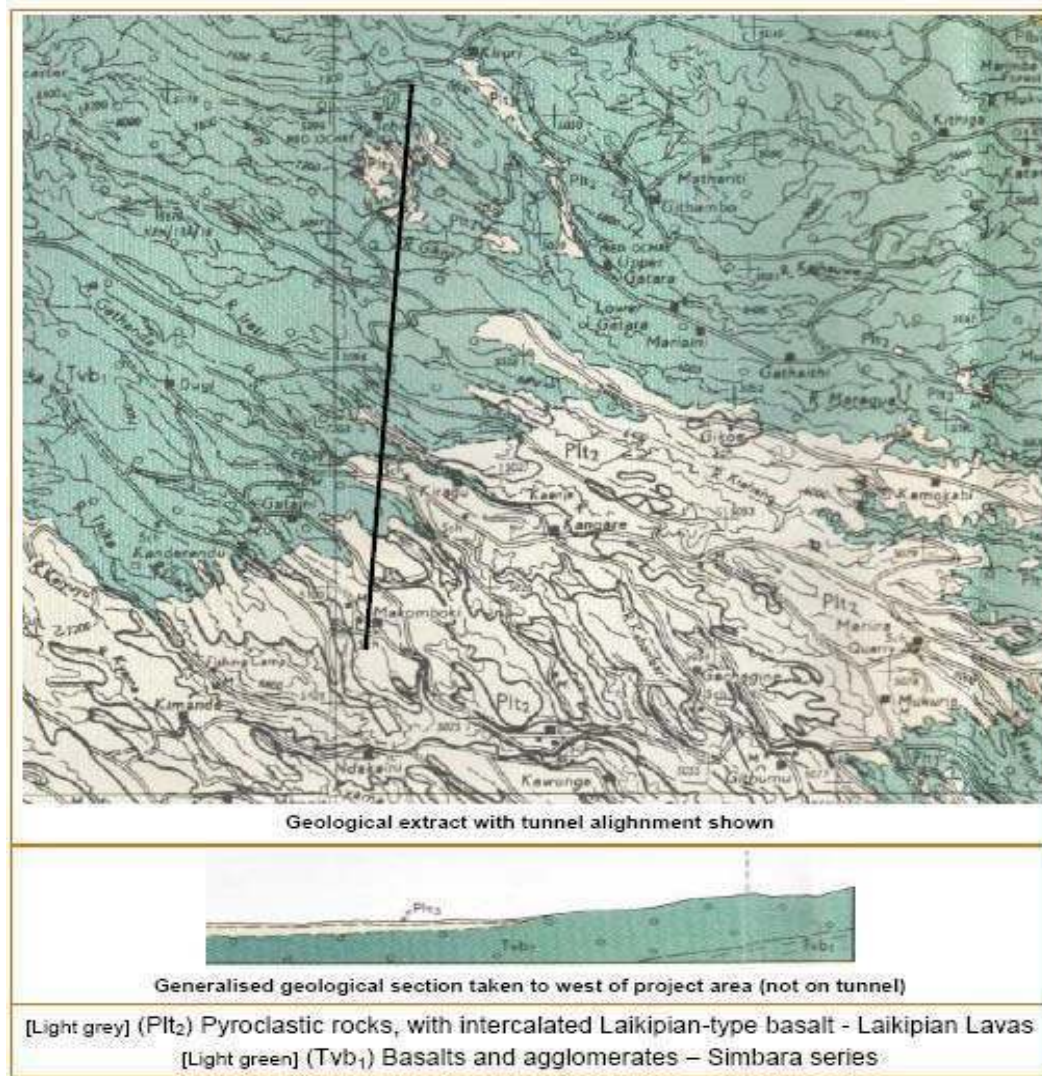


Figure 3-2: Geological map of the study area

Volcanic rocks exposed to tropical weathering generally decompose to give rise to thick profiles of clayey (normally red) residual soils. These clayey soils are typically of low density, moderate to low plasticity and generally more silty than clayey.

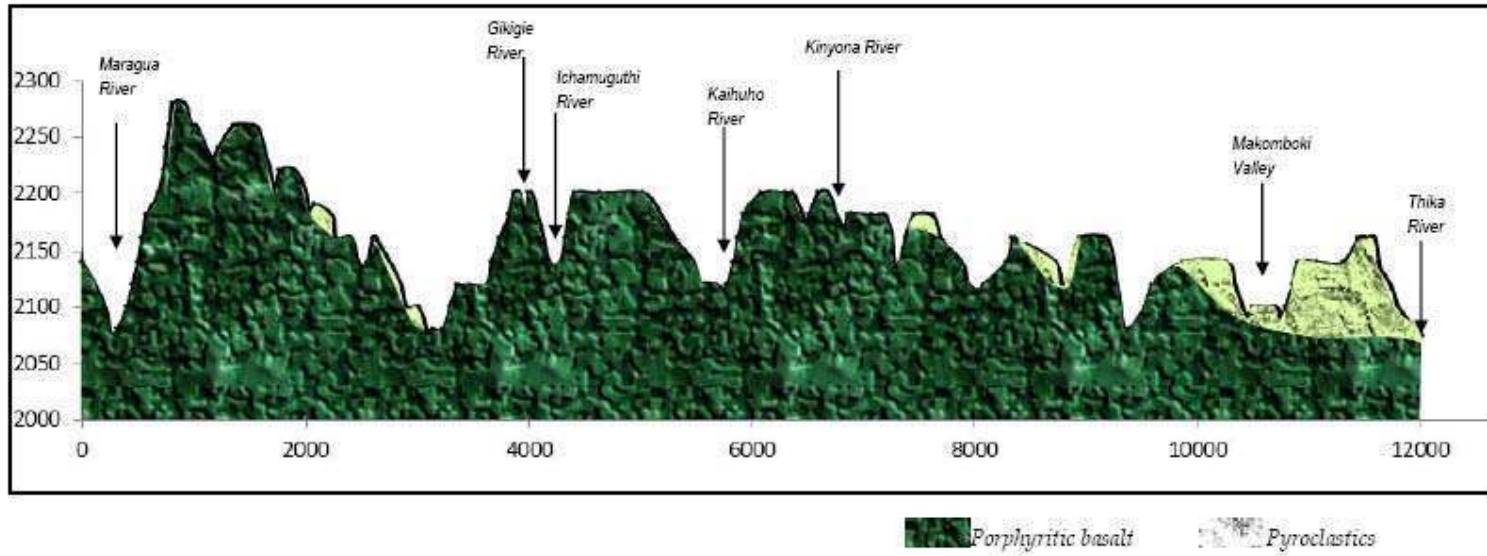


Figure 3-3: Geological section along the tunnel route (Vertical exaggeration=10)

3.1.4 Landslide hazards

Landslides are described as the downward movement of soil and rocks resulting from naturally occurring vibrations, changes in water content, removal of lateral support, loading with weight and weathering or human manipulation of water courses and the composition of the slope. In Kenya landslides and mudslides occur mostly during the rainy season and are accelerated by flooding.

According to Kenya National Disaster Profile developed by the United Nations Development Program (UNDP), Murang'a County is considered as one of the landslide prone areas in the mountainous region of central Kenya. This has mainly been attributed to deforestation to create way for farmlands. Landslides occur mainly on steep slopes where runoff is not well drained away. Other contributors to landslide in the region are:

- Population pressure and settlements built on steep slopes of the Aberdares and Mt. Kenya, softer soils and cliff tops which then succumb to gravity when the soil becomes too wet to hold together;
- Settlements built at the base of steep slopes, on mouths of streams from mountain valleys;
- Exploitation of the environment for economic reasons;
- Construction of roads, communication lines in mountain areas;
- Environmental degradation;
- Buildings with weak foundations;
- Buried pipelines and brittle pipes; and
- Lack of enforcement of the physical planning act allowing people to build in high-risk areas of the region

Landslides damage infrastructure, cause economic and social losses including displacement of settlements and sometimes loss of lives. In Murang'a there are reports of whole families being buried in the long rains of April and May in 2002 and 2003 (UNDP). During the field studies, a local farmer near Maragua River reported having his farm affected by landslide during the long rains of 2013.

3.1.5 Soils

The predominant soils in Murang'a are the deep and well-drained red/brown soils. They include well drained, extremely deep, dark reddish brown to dark brown, friable and slightly smeary clay loam to clay with acid humic top soil (ando-humic nitisols, and humic andisols).

These soils are loose and combined with the hilly terrain are easily eroded and sometimes are responsible for the landslides which are common in the county. Sometimes pockets of black soils are found around wetlands but these are more common in the low lands where cotton is grown.

Soil erosion is major environmental problem in the county. Most of the land in the district is hilly with sparse vegetation. Rill erosion is very common in cultivated land while gully erosion is found in unprotected drainage channels, footpaths and culvert outlets.

3.1.6 Hydrology and drainage

In terms of drainage, the three rivers under the project falls in Upper Tana River basin and Maragua River (4BE) Maragua and the main rivers are:

Irati River system: The Irati River, whose main tributaries are Kiahungu and Kayahwe Rivers, drains like Gacharage, Mariera, Gachocho and Kinyona and the Irati River discharges its waters into Maragua River. It merges with the Maragua River after flowing for 30.2km from the proposed intake.

Gikigie River system: The Gikigie River has no tributaries and drains areas like, Fort Winchester, Ichichi and Mununga and it discharges its water into Marugua River at Mununga.

The Gikigie River joins the Maragua River approximately 4.9km below the proposed Gikigie Intake Weir.

Maragua River system: Its tributaries include; Irati Gikie, Kiahungu, Kayahwe and Kameni Rivers. It drains areas like, Mirira, Gacharu, Gathiru, Ichichi, Kiruri, Gatara, Kionjoini, Gachocho, Gakoigo, and Gaturu and discharges into Tana River.

Githika River system: The Githika stream falls in the upper Athi River basin; it has no tributaries and drains the Makomboki area into Thika dam.

The estimated lengths of both Gikigie and Irati rivers from the proposed intakes and their confluence with Maragua River and between the proposed Maragua intake and confluence of Margua and Tana rivers are summarised in table below. Before the confluence with Tana River, Maragua River is harnessed through a weir to generate power at Wanjie hydropower station.

Table 3-3: Estimated river lengths between intakes and confluences

| River | Length (Km) | Remarks |
|---------|-------------|-----------------------------------|
| Gikigie | 4.9 | Confluence with Maragua River |
| Irati | 30.2 | Confluence with Maragua River |
| Maragua | 71.9 | Confluence with Tana River |
| Maragua | 61.0 | Up to Wanjii hydropower Reservoir |

Rivers Maragua, Irati and Gikigie drain an area of 556 km². The naturalised flow characteristics of the rivers are presented in Table 3-4 to Table 3-6.

Table 3-4: Mean monthly naturalized flow (m³/s) statistics for Irati River at the proposed intake

| Month | J | F | M | A | M | J | J | A | S | O | N | D |
|-------|-------|-------|-------|--------|--------|-------|-------|-------|-------|-------|-------|-------|
| Mean | 0.93 | 0.68 | 0.75 | 3.07 | 4.89 | 1.88 | 1.03 | 0.77 | 0.67 | 1.00 | 2.37 | 1.63 |
| Max | 36.28 | 26.39 | 29.29 | 119.67 | 190.74 | 73.48 | 40.20 | 30.07 | 25.94 | 38.98 | 92.59 | 63.70 |
| Min | 0.35 | 0.25 | 0.21 | 0.46 | 0.34 | 0.24 | 0.28 | 0.25 | 0.19 | 0.41 | 0.57 | 0.55 |

The mean monthly flow is highest 4.89 m³/sec in May and lowest 0.67 m³/sec in September. The maximum flow is highest 190.74 m³/sec in May lowest in 25.94 m³/sec in September. The minimum flow is highest 0.57 m³/sec in November and lowest 0.19 m³/sec in March.

Table 3-5: Mean monthly (naturalized) flow (m³/s) statistics for Gikigie River at proposed intake

| Month | J | F | M | A | M | J | J | A | S | O | N | D |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| Mean | 0.29 | 0.18 | 0.20 | 1.26 | 2.13 | 0.73 | 0.32 | 0.22 | 0.18 | 0.29 | 0.94 | 0.56 |
| Max | 1.67 | 0.58 | 1.14 | 5.17 | 6.3 | 2.75 | 1.96 | 0.57 | 0.38 | 1.62 | 6.75 | 2.69 |
| Min | 0.02 | 0.02 | 0.01 | 0.06 | 0.06 | 0.06 | 0.05 | 0.03 | 0.03 | 0.04 | 0.1 | 0.09 |

The mean monthly flow is highest 2.13 m³/sec in May and lowest 0.18 m³/sec in the months of February and September. The maximum flow is highest 6.3 m³/sec in May and lowest in 0.38 m³/sec in September. The minimum flow is highest 0.1 m³/sec in November and lowest 0.02 m³/sec in February.

Table 3-6: Mean monthly (naturalized) flow (m³/s) statistics for Marugua River at 4BE01

| Month | J | F | M | A | M | J | J | A | S | O | N | D |
|-------|------|------|------|-------|-------|------|------|------|------|------|------|------|
| Mean | 1.29 | 1.00 | 1.09 | 3.44 | 4.78 | 2.31 | 1.44 | 1.14 | 1.00 | 1.55 | 3.02 | 2.03 |
| Max | 4.33 | 2.3 | 4.53 | 17.08 | 10.04 | 5.87 | 4.76 | 2.25 | 1.73 | 4.33 | 14.9 | 5.77 |
| Min | 0.31 | 0.24 | 0.19 | 0.5 | 1.05 | 0.53 | 0.49 | 0.39 | 0.36 | 0.46 | 0.74 | 0.7 |

The mean monthly flow is highest 4.78 m³/sec in May and lowest 1.00 m³/sec in February. The maximum flow is highest 17.08 m³/sec in April and lowest in 2.25 m³/sec in August. The minimum flow is highest 1.05 m³/sec in May and lowest 0.19 m³/sec in the month of March.

Thika Dam: Thika Dam is located about 50 km north of Nairobi, close to Ndakaini village and was constructed between 1989 and 1994 under the Third Nairobi Water Supply Project. It is a river regulating reservoir to augment water supply to Nairobi by ensuring adequate flows at Ngethu Treatment works. It collects water from Thika River and its tributaries. Water from this reservoir is transferred by a series of tunnels into Chania River from which an intake exists for transfer to Ngethu treatments works.

The main characteristics of the reservoir are listed in Table 3-7.

Table 3-7: Thika Dam Characteristics

| Dam Component | Characteristics |
|--------------------------|--|
| Height of the dam | 65m |
| Reservoir water surface | 2.8 km ² |
| Full Water Supply Level | 2041m AOD |
| Spillway Crest length | 420m |
| Capacity of reservoir | 70 million m ³ |
| Catchment area | 75 km ² |
| Tunnel length | 340m |
| Tunnel diameter | 3m |
| Draw-off pipe | 1400mm with 6 draw-off valves |
| Spillway characteristics | H= 65m, shaft diameter: 5.5m |
| Tunnel | Discharge: 390 m ³ /s, length: 180m |
| Emergency spillway | Qmax=120 m ³ /s |
| Thika-Kiama tunnel | L= 1km, D= 2.5m, Q= 6 m ³ /s |
| Kimakia – Chania tunnel | L= 3km, D= 2.5m, Q= 6 m ³ /s |

Source: Feasibility study and master plan for developing new sources of water for Nairobi and satellite towns – Master Plan Report

The intake shaft is located on the southern edge of the reservoir. A discharge valve regulates the outflow to the Thika – Kiama transmission tunnel. The 1,400mm intake has been designed for a maximum flow of 5.7m³/s. A second draw off structure has been constructed to supply irrigation, compensation and demand from a future high-level treatment works.

Figure 3-4 presents the major rivers within the project area.

Figure 3-4: Major rivers in the project area

3.1.7 Water Resources and key uses

(a) Surface water resources

Water is used for multiple purposes among them being domestic, livestock, agriculture (irrigation minor) and industry (tea processing). Water has been tapped from the rivers, springs and streams using pipes. Others practise roof harvesting while others source water from shallow wells. Some homesteads get piped water from water service providers within the area while others have laid pipes tapping water from nearby springs. However there are others who rely on water taken directly from the rivers and seasonal streams. The water service providers in the two sub-counties as listed below (with exception of Gatamathi W&S Company) get their major supplies from Irati and Maragua rivers:

- Murang'a Water and Sanitation Company;
- Kahuti Water & Sanitation Company;
- Gatamathi Water And Sanitation Company; and
- Murang'a South Water & Sanitation Company

The existing licensed and actual abstraction volumes by the water service providers is presented in Table 3-8.

Table 3-8: Existing licensed and actual water abstractions on the project river basins

| Name of WSP | Location of Intake | Licensed Abstraction (m ³ /day) | Current Abstraction (m ³ /day) |
|---|---------------------------------------|--|---|
| Murang'a Water and Sanitation Company | Irati River | 26,000 | 11,000 |
| Murang'a South Water and Sanitation Company | Maragua River Irati River | 53,900 | 30,000 |
| Kahuti Water and Sanitation Company | Maragua River South Mathioya River | 9,600 | 9,600 |
| Murang'a Water and Sanitation Company | Irati River | 26,000 | 11,000 |
| Total | | 89,500 | 50,600 |

Source: Muranga county water office 2014

In addition to the above abstractions, Maragua river (downstream the proposed intakes) is harnessed for non-consumptive hydropower generation by Kengen in three hydropower stations. All of the stations are located downstream of the Maragua confluence with Gikigie and Irati rivers and their capacities and volumes used are shown in Table 3-9.

Table 3-9: Hydro power stations in the Maragua basin

| Name of power station | River source | Quantity of water used (m ³ /day) | Amount of power generated (KW) |
|-----------------------|--------------|--|---------------------------------|
| Mesco | Maragua | 129,600 | 480 KW |
| Wanjii | Maragua | 368,181 | 2 MW |
| Tana | Maragua | Not available | Not available |
| | Sagana | Not available | |

Mesco power station is about 4km upstream of Wanjii power station, while Tana power station is about 16 km downstream of Wanjii station. In between Wanjii and Mesco power stations, there is a stream tributary entering Maragua River.

There are many sources of water pollution in the two sub-counties. These include coffee and tea factories, car washing, soil erosion and agrochemicals used in agriculture production. However, within the project area no industrial effluents are discharged into the rivers before or immediately after the proposed river intakes.

(b) Underground water resources

Available quantitative information on the area's groundwater reviewed is old (National Environment and Human Settlements Secretariat, 1982) and indicates that most boreholes in Murang'a County are located in the lower altitude areas to the east. The average borehole yields in the area is 7.13m³/hr but ranges from nil to 50m³/hr. the average borehole depth is 117.0m but water is commonly struck at a depth of 84.4m with average water resting level of 42.8m.

According to the Murang'a district environmental action plan 2006-2011, springs, wells and boreholes in the area are safe for consumption and other uses. However, these are currently under-exploited while springs and shallow wells also have a challenge of bacteriological contamination.

3.1.8 Air Quality

There were no previous air quality studies in the project area available for review. However, given the dominance of agricultural land use with no major industrial establishments, save from few small-scale tea factories, there are currently no concerns of air quality deterioration within the project area. Potential impacts on air quality will depend on how effectively the contractor manages the suppression of dust during the construction phase. The potential impact of the proposed project on local air quality will be much localised and will only pose a risk to immediate neighbours if not handled efficiently. Specialist assessment of the potential impact of dust was not prescribed but the potential impacts have been addressed in the EMP.

3.1.9 Noise

Given the predominantly rural character of the project area, existing noise levels are generally low and are not expected to pose any nuisance. The main background natural noise in the area is from rapids along the rivers perceivable from settlements near them. Notable existing sources of artificial noise are limited to transport-oriented activities including irregular movements of vehicles and motor bikes (*boda boda*). Noise from these sources is perceivable from settlements which are mainly located along the roads due to hilly terrain. In limited neighbourhoods, tea factories also form a source of noise.

Day-time noise levels at nine potential receptor areas relative to the key project activities are presented in Table 3-10 below.

Table 3-10: Existing noise levels at potential receptors closest to project's noise sources

| Area | Coordinates | Noise levels | | Comments |
|---|--------------------|--------------|-------------|--|
| | | Min. dB (A) | Max. dB (A) | |
| Makomboki Trading Centre | 0259365 9911546 | 37 | 68 | Likely major receptor of noise from activities at the tunnel outfall site (approximately 151m away). Current major sources of noise are <i>matatus</i> and motorbikes stage and their movements, stopping and speeding off after dropping or picking passengers. |
| Mairi Trading Centre | 0258608 9915040 | 36 | 54 | About 450m from Kaanja adit portal to be used for tunnel construction and maintenance access. Some road rehabilitation works were on-going at the time of the study. |
| Gitaigua Tea Buying centre | 0259605 9917824 | 31 | 47 | 160m from the Irati intake site. The tea buying centre is not continuously occupied as farmers only deliver tea for collection by trucks. |
| Rural homestead | 0259685 9920080 | 27 | 44 | Approximately 120 from Gikigie intake works |
| Rural homestead | 0259944 9920124 | 28 | 45 | Approximately 181m from Gikigie intake works |
| Rural homestead | 0259216 9922518 | 24 | 41 | Near potential spoil area for Maragua intake works and likely to be affected by frequent truck movements during construction. |
| Ichichi Primary school | 0260072 9922610 | 35 | 50 | At about 501m from the Maragua intake works and 161 from Ichichi trading centre |
| Ichichi trading centre | 0260145 9922466 | 36 | 60 | Trucks hauling spoil materials are likely to make numerous trips through this centre to and from the potential spoil site. Site is also about 662m direct distance from the intake works. |
| Maragua Tea Collection centre, church and residential units | 0260453 9923006 | 47 | 63 | This centre is near the proposed Maragua River intake works and lies near one of the other potential spoil site. It is anticipated that those closest to the works area will be resettled to pave way for contractors' camp and secure the intake. |

Source: Gibb Africa studies, 2014

The above reference points area also presented in the project area's map as shown in

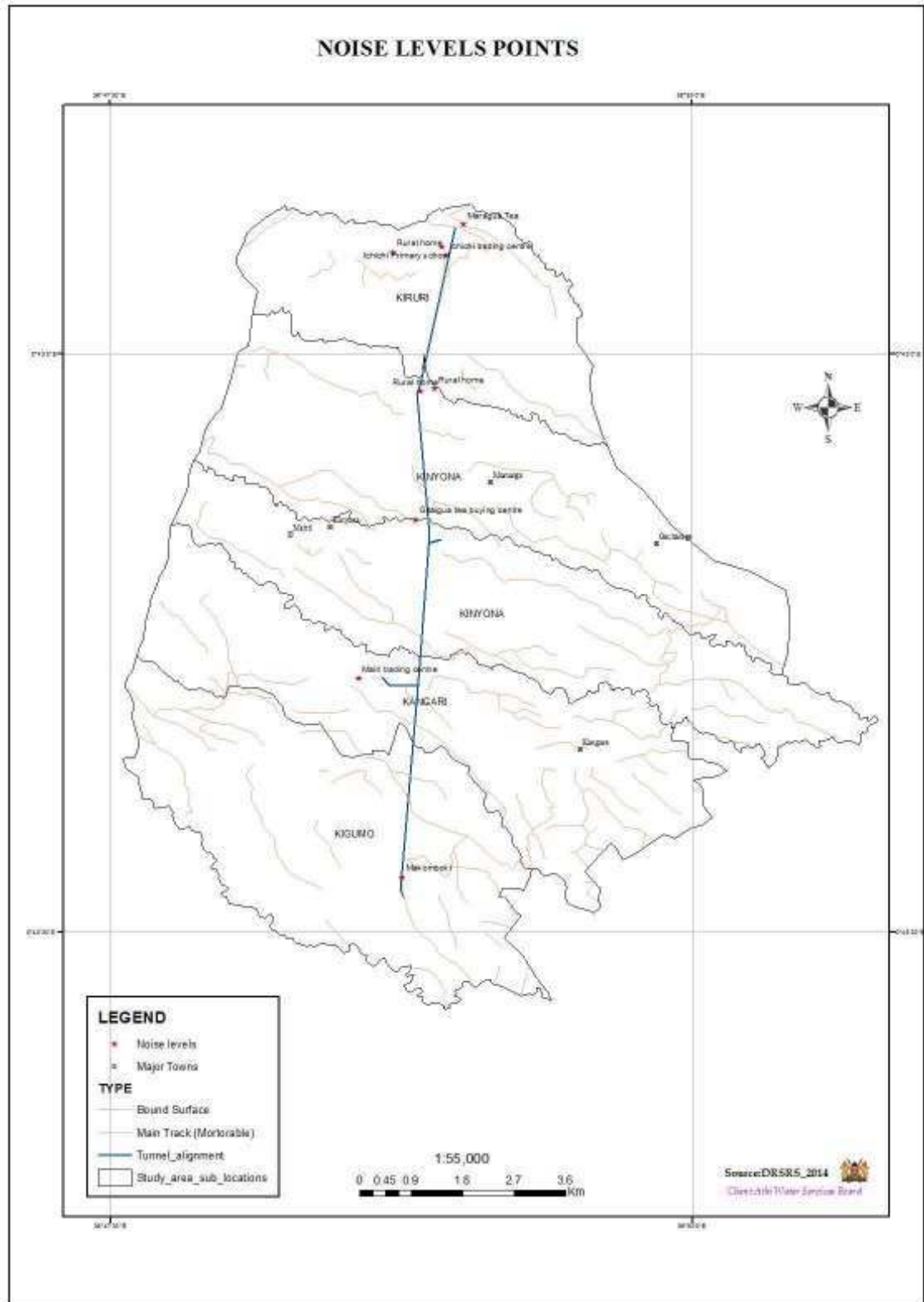


Figure 3-5: Map of Baseline noise measurement points

3.2 Biological Environment

Ecological data was collected in the rivers using stream reaches and transects established in 6 sampling sites namely rivers Maragua, Gikigie, Irati, Githika, downstream of the River Maragua where Irati and Gikigie meets R. Maragua and the confluence of Rivers Maragua and Sagana forming the Tana river (see section 1.4.5 and Figure 1-6).

3.2.1 Fauna

The project ecological study yielded a total of 77 species of fish and aquatic macro-invertebrates from different taxa groups including; Arthropods, mollusks, annelids and fish. In terms of species composition and richness by taxa as shown in Figure 3-6 and from highest to lowest in that order; 13 Coleoptera (beetles), 12 Trichoptera (caddisflies), 11 Odonata (dragon flies and damsel flies), 10 Hemiptera (aquatic bugs) 7 Pisces (fish), 6 Diptera (flies), 5 Ephemeroptera (mayflies), 2 Decapoda (crabs), 2 Annelida (earthworms and leeches) and 1 Mollusca (bivalve), 1 Isopoda (water lice), 1 platyhelminthes (flatworm), 1 Lepidoptera (moth), 1 Plecoptera (stonefly), 1 Amphibian (frog), 1 reptile (snake), 1 Arachnida (Spiders) and 1 Carnivora (otter). The comprehensive list of faunal species is presented in Appendix II.

Of the seven fish species, the mountain catfish *Amphilius uranoscopus* and *Garra dembensis* were recorded only in the four upper streams but not at Lower River Maragua neither at the confluence of Rivers Maragua and Sagana suggesting they require cooler temperatures.

A green non-poisonous snake was spotted in the confluence near Napier grass planted along the river in the furthest stream reach sampled.

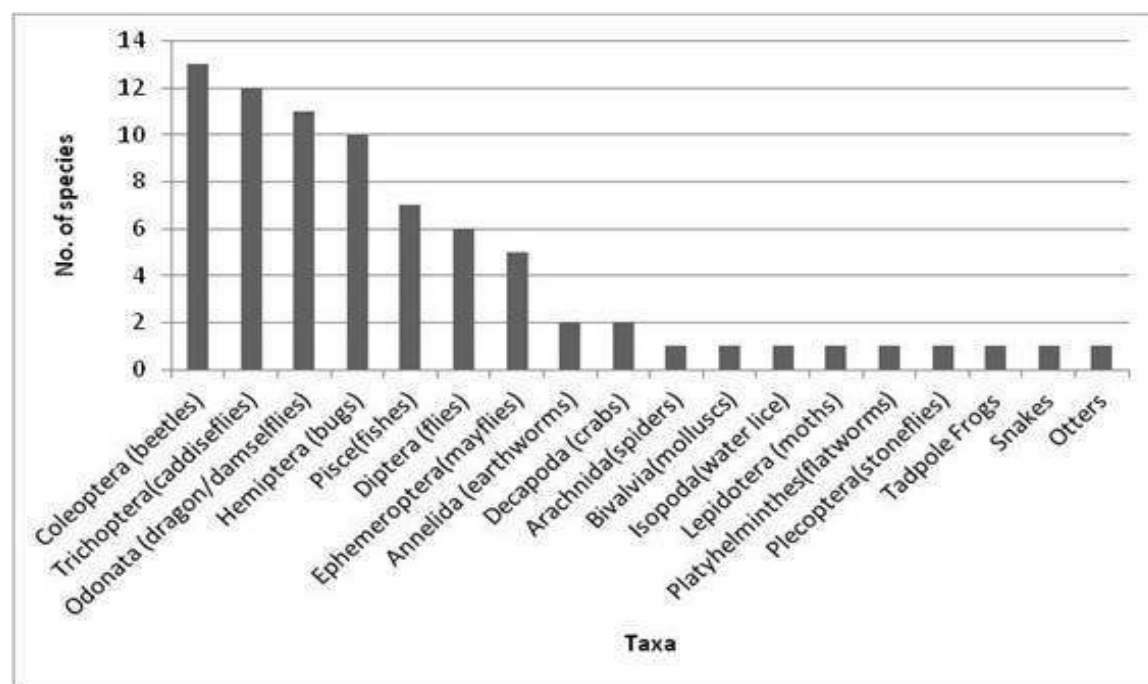


Figure 3-6 Number of species per major Taxa (Order or Class)

R. Gikigie recorded the highest species composition (42) and species diversity index $H' = 3.365$ followed by R. Githika and lower R. Maragua at 37 while the confluence of rivers Maragua and Sagana recorded the least species (19) and also the lowest species diversity index $H' = 2.713$. see Figure 3-7 and Table 3-11.

In terms of unique species per site (Table 3-12), lower R. Maragua recorded the highest number (9), followed by the confluence of Rivers Maragua and Sagana (6) while R. Irati recorded only one unique species.

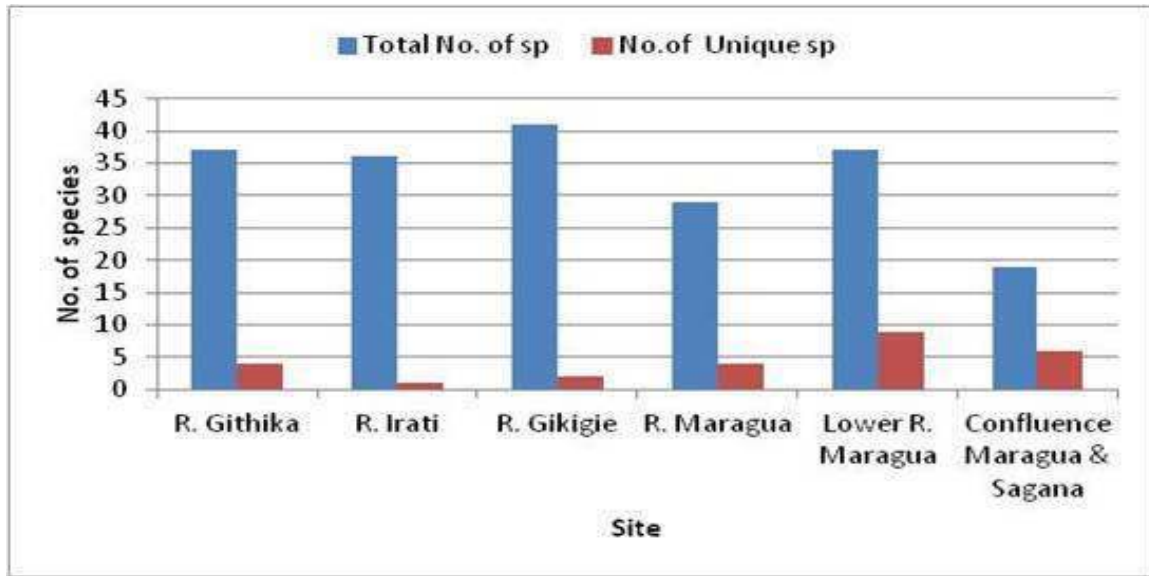


Figure 3-7: Species composition of fish and aquatic macro-invertebrates of Maragua rivers per site and number of unique species site

Table 3-11: Species diversity index of fish and aquatic-macro invertebrates of NCT1

| Site | S | N | d | J' | H'(Loge) |
|--------------------------------|----|-----|----------|----------|----------|
| R. Githika | 37 | 117 | 7.559573 | 0.921671 | 3.32808 |
| R. Irati | 36 | 132 | 7.168016 | 0.913999 | 3.275334 |
| R. Gikigie | 42 | 131 | 8.409916 | 0.900327 | 3.365126 |
| R. Maragua | 31 | 146 | 6.019737 | 0.916889 | 3.148583 |
| Lower R. Maragua | 37 | 93 | 7.942462 | 0.932095 | 3.365717 |
| Confluence of Maragua & Sagana | 19 | 36 | 5.022996 | 0.921731 | 2.71398 |

Key: H' = Shannon-Wiener diversity index; J' = Pielous evenness index; d = Margalef's richness index
S = Total faunal species

The dominant species by percent occurrence was the black fly larvae *Simulium* spp. represented 69%, followed by the minnow mayflies *Baetidae* sp (68%), while among the fishes the most dominant species was the *Amphilius uranoscopus* (32%) (Figure 3-8).

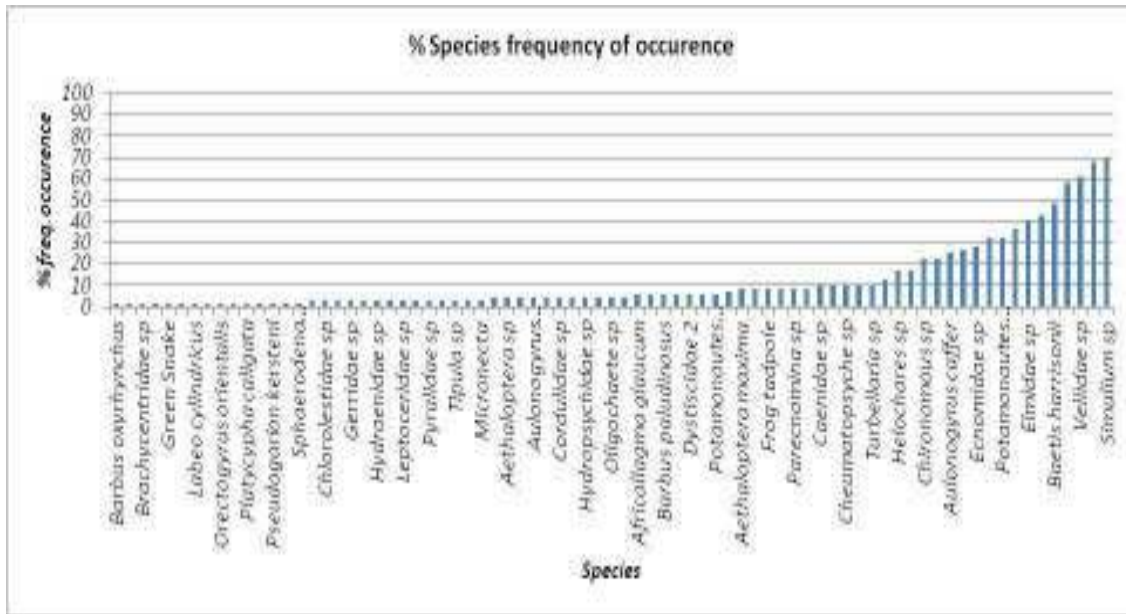


Figure 3-8 Percent frequency of occurrence Species in all 6 rivers combined

There was no significant differences in total species number between the riffle and pool sequence between different sites, stream reaches and transects ($DF^1=119$, $F^2=0.46$, $P^3>0.05$) although different species were adapted to either riffle or pool (Table 1-microhabitats column). This contradicts other studies where riffles are known to be up to 20 times more productive than pools in the headwaters in natural rivers (e.g. Allan, 1995). This could be due to interference by man on the canopy vegetation which had been cleared before the project screening exercise and replaced with exotic vegetation of *Eucalyptus*, *Clidemia*, etc. Owing to the open nature of these rivers the role of *Autochthonus* primary production by diatoms, filamentous algae and mosses could be the main source of food for first order consumers including also allochthonous organic material from the riparian vegetation in the catchment.

¹ DF=Degree of freedom, defines the estimated mean in a group of observations;

² F= Ration of sample variance, testing if variances of two populations are equal; and

³ P=Significance level, estimated probability of rejecting the results.

Table 3-12: List of unique species encountered per site during the study

| Site | No. | Species/common name | Common name |
|---|-----|-------------------------------|---------------------------|
| R. Githika | 1 | <i>Pantalla flavescens</i> | Dragonfly |
| | 2 | <i>Orectogyrus orientalis</i> | whirlgig beetles |
| | 3 | <i>Yola tuberculata</i> | Predator diving beetles |
| R. Irati | 1 | <i>Pyralidae sp</i> | Aquatic caterpillar Moth |
| R. Gikigie | 1 | <i>Garra dembensis</i> | Dembea stone lapper fish |
| | 2 | <i>Micronecta sp</i> | aquatic bugs |
| R. Maragua | 1 | <i>Brachycentridae sp</i> | Caddisfly |
| | 2 | <i>Sigara sp</i> | Water boatman |
| | 3 | <i>Dytiscidae 2</i> | Predator diving beetles |
| | 4 | <i>Gomphidae sp</i> | Dragonflies |
| Lower R. Margua | 1 | <i>Africallagma glaucum</i> | Damselfly |
| | 2 | <i>Barbus sp</i> | Barbs fish |
| | 3 | <i>Hirudinae sp</i> | Leeches |
| | 4 | <i>Hydraenidae sp</i> | Minute moss beetles |
| | 5 | <i>Labeo cylindricus</i> | Redeye Labeo fish |
| | 6 | <i>Laccocoris limigenus</i> | Water creeping bugs |
| | 7 | <i>Platycypha caligata</i> | Damselfly |
| | 8 | <i>Psephenus sp</i> | Water penny beetle |
| | 9 | <i>Sphaerodena nephoides</i> | Water bugs |
| Confluence of Rivers Maragua and Sagana | 1 | <i>Barbus paludinosus</i> | Straightfin Barb fish |
| | 2 | <i>Geriidae sp</i> | Pond skaters |
| | 3 | <i>Corlubridae sp</i> | Non-poisonous green Snake |
| | 4 | <i>Oreochromis spirulus</i> | Athi river tilapia |
| | 5 | <i>Barbus oxyrhynchus</i> | Pangani Barb fish |
| | 6 | <i>Leptoceridae sp</i> | Caddisfly |

(a) Aquatic fauna of conservation significance

Of all the encountered 77 aquatic fauna species, none is listed in the IUCN Red-list. However, some of the aquatic species documented above are short distance migratory fish species that move to feed and spawn such as the *Labeo cylindricus*, *Barbus sp*, *Garra dembensis* and other aquatic invertebrates and long distance migratory species for feeding and spawning purposes such as the eel *Anguilla bengalensis*, *Oncorhynchus mykis*, *Salmo trutta*.

(b) Birds

Very few birds were spotted during the field study as tabulated below. All the spotted birds are of least conservation concern.

Table 3-13: List of birds spotted on site

| | Scientific name | Common name |
|---|----------------------------|---------------------------------|
| 1 | <i>Nectarinia sp</i> | Eastern double Collared sunbird |
| 2 | <i>Pycnonotus barbatus</i> | Common bulbul |
| 3 | <i>Estrilda astrild</i> | Common waxbill |
| 4 | <i>Ceryle rudis</i> | Pied Kingfisher |
| 5 | <i>Bubulcus ibis</i> | Cattle egret |
| 6 | <i>Ploceus sp</i> | Weaver bird |
| 7 | <i>Saxicola torquatus</i> | Common stonechat bird |
| 8 | <i>Alcedo cristata</i> | Malachite kingfisher |

On the other hand KWS and UNEP (2003) reported 276 bird species occur in the nearby Aberdares which is an Important Bird Area (IBA No 1).

(c) Other fauna

The following fish species which were not recorded during this project's ecological survey but have been reported in the past in this area by different authors (e.g. Van Someren, 1952; Frost 1955; Boulenger, 1909-1916; (Copley, 1958) and also from indigenous knowledge from fishermen and local people:

(i) Native species:

Anguilla bengalensis- local fishermen and some Ken Gen staff at Wanjii Reservoir reported its occurrence which was reported to be food delicacy and more so the fishermen indicated they used to sale to certain Chinese nationals sometime back.

(ii) Introduced species:

- 1 *Oncorhynchus mykiss* (Rainbow trout) upper Tana- Aberdares rivers,
- 2 *Salmo trutta* (salmon) upper Tana- Aberdares rivers and
- 3 *Salmo gaidneri* (Salmon) upper Tana- Aberdares rivers,
- 4 *Cyprinus carpio* (Common carp) middle Tana river

None of these species is listed as of conservation concern in the IUCN red data list and the Kenya wildlife conservation and management Act of 2013.

3.2.2 Flora

Tea plantations have significantly changed the vegetation types in the project area. Only small pockets of natural vegetation still exists in the project area but the tree species dominating the landscape is *Eucalyptus* (mubau / blue gum).

(a) Floristic composition

A total of 279 species belonging to 89 families and 212 genera were recorded in the entire sampling from 44 sampled points, which were along narrow belts on the stream reaches, hardly exceeding 10 meters from the river. They excluded cultivated crops such as maize, potatoes, bananas and tea. Among the recorded species were six listed as either endemics, threatened or protected under CITES against trade. Some species, mostly the common weeds were considered as indicators of disturbance but presence of invasive species including the notorious *Clidemia hirta* (Koster's curse)

were noted in most of sampled area. The comprehensive list of floral species is presented in Appendix III.

Some of the most frequent species, in the order of abundance included; *Triumfetta brachyceras* (Tiliaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Ageratum conyzoides* (Compositae), *Panicum calvum* (Graminae), *Drymaria cordata* (Caryophyllaceae), *Spermacoce princeae* (Rubiaceae), *Macaranga kilimandscharica* (Euphorbiaceae), *Pennisetum purpureum* (Graminae) and *Conyza bonariensis* (Compositae) Overall, Compositae (Asteraceae) was the most diverse plant family contributing to 12% of the species. Other well-represented families included Gramineae (Poaceae), Papilionaceae, Cyperaceae, Labiatae, Euphorbiaceae, Rubiaceae and Acanthaceae. Over a half of the recorded families (54%) were represented by a single species.

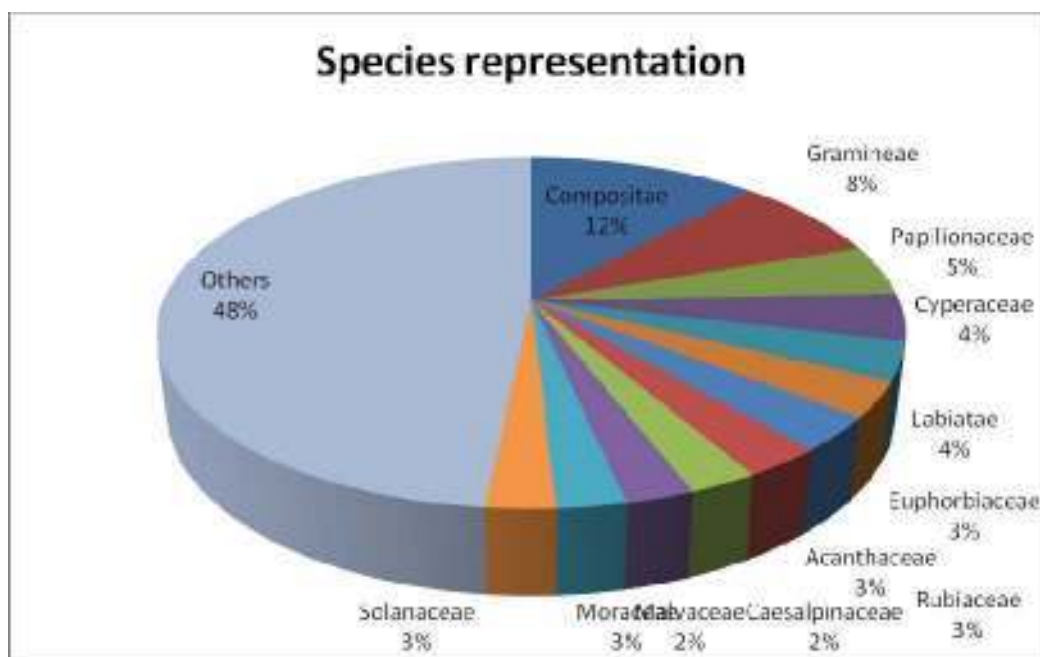


Figure 3-9 Overall percentage family representation

Basing on the known growth habits of plants, a life form spectrum was created. In overall, herb was the most dominant life form constituting 52% of the entire diversity. Climbers were least at 8%. With herbs and climbers occupying almost 70% of the river banks, the indication of the openness of the canopy and extreme encroachment in the project areas can be concluded.

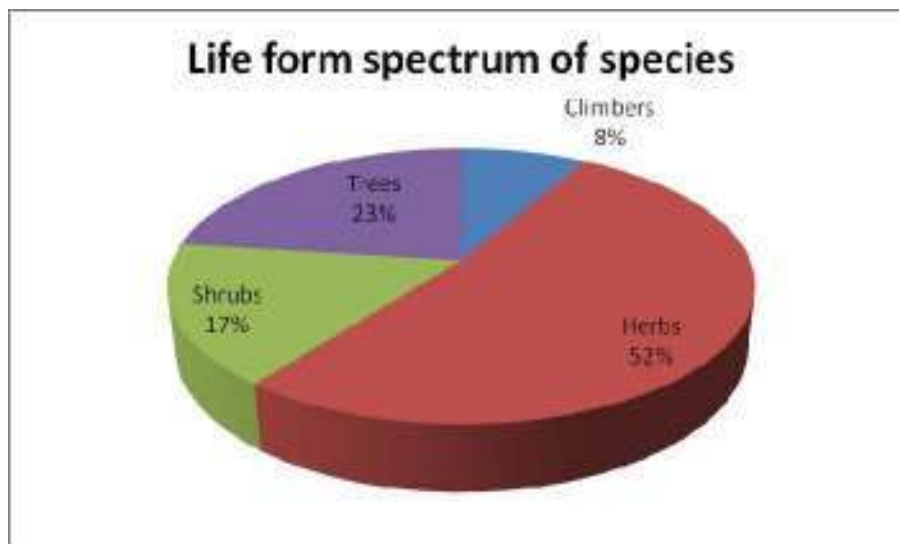


Figure 3-10 Life form spectrum of species

(b) Floral Species diversity

Maragua River was the most diverse of the six sampled sites, with a Shannon-Wiener diversity index of 4.73. It also had the highest species richness. Its species distribution was however not among the most even. Lower Maragua site was the least diverse with an index of 4.13. The site just before the Wanjii Kengen reservoir had increased turbidity and a considerable number of invasive plants. The site is by the main tarmac, has close proximity to Muranga town as well as an existing quarry site and numerous pollution indicators were noted.

Table 3-14 Plant diversity and evenness indices within sampled sites

| | Gikigie | Githika | Irati | Maragua | Lower Maragua | Confluence of Maragua & Sagana rivers |
|---------------------------------|---------|---------|-------|---------|---------------|---------------------------------------|
| Species No. per site (S) | 80 | 94 | 103 | 148 | 73 | 81 |
| Diversity H' (Log e) | 4.19 | 4.29 | 4.38 | 4.73 | 4.13 | 4.26 |
| Richness (d) | 14.68 | 16.50 | 18.33 | 24.17 | 15.04 | 16.51 |
| Evenness (J') | 0.96 | 0.94 | 0.95 | 0.95 | 0.96 | 0.97 |

(c) Botanical uniqueness

Three of the recorded species although not aquatic plants but occur on montane forest valleys are listed by IUCN as vulnerable to various threats. The three were also found to be either Kenyan or regional endemics. All Kenyan native orchids are protected by CITES, therefore the two encountered orchids are of conservation concern. Orchids have high specificity to moist ecosystems, making the rivers in subject important for their continued survival. Rampant trade in the bark of *Prunus africana* for its medicinal value has enabled it to be restricted by CITES.

Table 3-15 Plant Species of Conservation Interest

| Family | Species | Endemic/ conservation | IUCN status | Source/ reference |
|--------------------|-----------------------------|--------------------------------|--------------------|--|
| Araliaceae | <i>Polyscias kikuyensis</i> | Kenyan endemic | Vulnerable | EA; IUCN 1997, UFT (VOL 1 NO 3) 1988; FTEA, 1968, KTSL Sixth schedule, Wildlife Conservation and Management Act, 2013 |
| Orchidaceae | <i>Aerangis thomsonii</i> | Kenyan orchid | Protected by CITES | CITES |
| Orchidaceae | <i>Polystachya sp</i> | Kenyan orchid | Protected by CITES | CITES |
| Rocaceae | <i>Prunus africana</i> | Protected by CITES | Vulnerable | IUCN 2014 Sixth schedule, Wildlife Conservation and Management Act, 2013 |
| Rocaceae | <i>Rubus keniensis</i> | Kenyan endemic | Vulnerable | FTEA, 1960 |
| Rocaceae | <i>Rubus steudneri</i> | Regional endemic (KE, UG & TZ) | | KTSL, FTEA |

(d) Algae

A total of 19 species of algae belonging to the following phyla; Chlorophyta (green algae), Bacillariophyta (diatoms), C and Cyanophyta (blue green algae) were recorded in different sites. R. Gikigie and R. Githika recorded the highest species number of 10 while the confluence recorded the least (3) as shown in Figure 3-11.

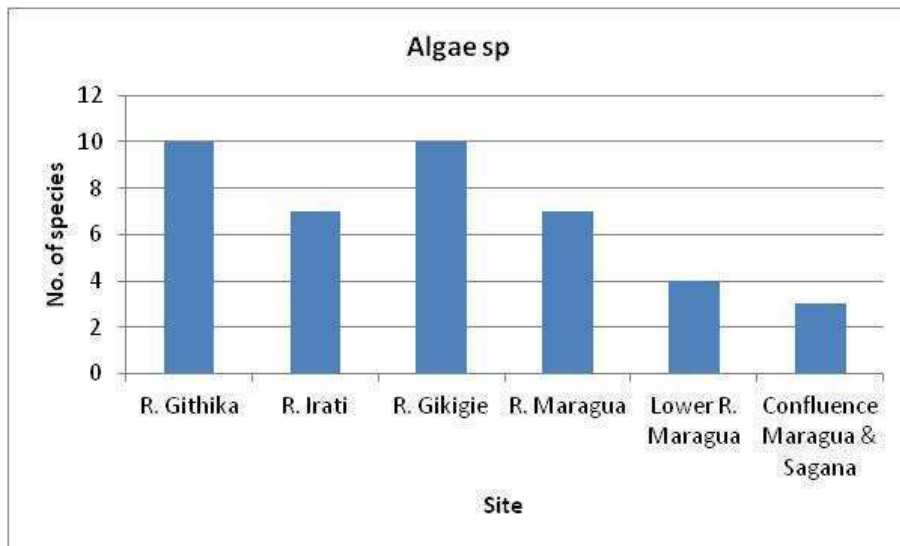


Figure 3-11: Species composition of algae in different sites

Full list of the algae species is presented in Appendix IV.

(e) Threats to Plants and Existing Ecologically Sensitive Areas

An objective categorization of vegetation of wider area surrounding the sample sites on the upper rivers are patchy remnants of upland montane forests of tall trees. Basing on remnant emergent plants in the valleys, the entire area's vegetation would have resembled the highlands of Aberdare forest, with possible composition of *Ocotea-Macaranga-podocarpus-Cassipourea* emergents coupled with *Xymalos*, *Maesa*, *strombosia* and *Manilkara* mid canopy. Development in agriculture is highly attributed to the depletion of the original forest vegetation.

On the lower part of the Maragua River at the confluence with Sagana, dryland forest vegetation was noted. Further from the river, the vegetation type can be described as *Combretum collinum- Acacia polyacantha* woodland with understory shrub mainly of *Acacia brevispica*.

The invasive *Lantana camara* shrub was also noted to be with high densities at area near the confluence. Other invasive species recorded at the upper river sections included the notorious *Clidemia hirta* (Koster's curse), a native of the American neotropics, which since introduction to East Africa has colonized massive land areas. Some species recorded that include the common weeds are indicators of disturbance. They constituted approximately 15% of the entire plant list and include *Tithonia diversifolia*, *Achyranthes aspera*, *Galinsoga parviflora*, *Ageratum conyzoides*, *Dichrocephala integrifolia*, *Senna didymobotrya*, *Oxygonum sinuatum*, *Brugmansii suaveolens*, *Solanum Campylacantha*, *Solanum mauritianum*, *Lantana camara* and *Ricinus communis* among others. The proportion of weeds was notably high and was considered a clear indication of how human activities have taken toll on the riverine ecosystem. Remnant patches of forests on ridges and along the valley, nearby wetlands and the dry woodlands near the confluence were considered as ecological sensitive areas based on the threats faced and therefore the Maragua and associated rivers play important ecological roles within these habitats. In fact, the entire river stretch may be considered a sensitive area.

3.3 Social Characteristics

Socio-economic study established the following baseline living and operational conditions of the persons within the projects primary and its secondary zones of impact.

3.3.1 Population size and composition

The Population and Housing Census conducted by the KNBS in 2009 established that Murang'a County has a population of 936,228 of which 451,751 are males and 484,477 females. The projected growth rate for the County was placed at 0.4 percent per annum. This population is projected to rise to 947,530 in 2012; 958,969 in 2015 and 966,672 persons in 2017. The male: female sex ratio for the county is 48:52. The higher female population in relation to male is attributed to high male emigration to other counties and towns in search of employment and business opportunities.

The above was reinforced by the results of the project study conducted in August 2014 by GIBB Africa as reflected in Table 3-16 below. Male population within the age brackets of 10 to 39 years are few in the project area. This category is considered to be comprised of persons of high productivity and make the labour pool which can be sourced to assist in the construction and operation works of the tunnel.

Table 3-16: Population distribution (%) according to Sex

| Age in Years | Sex | |
|--------------|----------|------------|
| | Male (%) | Female (%) |
| 0-4 | 9.26 | 5.09 |
| 5-9 | 8.95 | 8.08 |
| 10-14 | 8.02 | 9.28 |
| 15-19 | 8.64 | 9.88 |
| 20-24 | 8.95 | 9.28 |
| 25-29 | 6.17 | 10.18 |
| 30-34 | 7.72 | 8.68 |
| 35-39 | 8.95 | 10.48 |
| 40-44 | 9.26 | 7.78 |
| 45-49 | 5.86 | 5.69 |
| 50-54 | 6.48 | 4.79 |
| 55-59 | 1.85 | 3.59 |
| 60-64 | 5.86 | 2.40 |
| 65+ | 4.01 | 4.79 |

Population density and distribution within the sub-counties hosting the project are as reflected in Table 3-17.

Table 3-17: Population density and distribution

| Sub-county | 2009 (Census) | | 2012 (Projections) | | 2015 (Projections) | | 2017 (Projections) | |
|--------------|----------------|----------------------------|--------------------|----------------------------|--------------------|----------------------------|--------------------|----------------------------|
| | Population | Density (Km ²) | Population | Density (Km ²) | Population | Density (Km ²) | Population | Density (Km ²) |
| Kangema | 76,988 | 443 | 77,917 | 449 | 78,858 | 454 | 79,491 | 458 |
| Kigumo | 123,766 | 511 | 125,260 | 517 | 126,772 | 524 | 127,791 | 528 |
| Total | 942,581 | 368 | 953,960 | 373 | 965,477 | 377 | 973,231 | 380 |

Source: Muranga County Development Profile

3.3.2 Household Headship

Majority (68.75%) of the households in the project area are male headed. Approximately 31.25% of the surveyed population from project area noted that their households are female headed.

3.3.3 Religion

In the country, Christianity is the largest religion at 82.5% where 47.4% are Protestants, while 23.3% are Catholics. Muslims form about 11% of the population. From the survey, approximately 79.94% of the project host community are Christians, of which 67.33 are Protestants and 12.61 are Catholics as shown in Table 3-18.

Table 3-18: Religious affiliations

| Religion | Percentage response |
|----------------|---------------------|
| Protestant | 67.33 |
| Indigenous Ch. | 19.30 |
| Catholic | 12.61 |
| None | 0.76 |
| Total | 100.00 |

This relative homogeneity in belief systems reflected by the response of a majority of the population will ease the process of resettlement and integration in case there will be need of relocation of the affected population from the proposed wayleave.

3.3.4 Education

Murang'a County has 634 primary schools, 6,324 teachers, total enrolment of 214,986 and a transition rate (proportion of students from the primary level who move to the next level) of 70 percent. Again, at the county, net set secondary school enrolment rate is 71.04% for both boys and girls. On average 70% of the members of the community live between 1.1km and 4.9km to the nearest primary school. This figure tallies with results from the baseline survey study in the project area in which 100% of the surveyed population live less than 5kms from the nearest primary school.

(a) Population currently in school

Majority of the children who are of school going age in the project area are currently in school. Of the surveyed population 48.44% of persons in school accounted for children within the age bracket of 5-14 years as shown in Table 3-19 below.

Table 3-19: Population (%) currently in school

| Age in Years | Currently in School | |
|--------------|---------------------|------------|
| | Yes | No |
| 0-4 | 6.22 | 7.62 |
| 5-9 | 23.56 | 0.69 |
| 10-14 | 24.89 | 0.23 |
| 15-19 | 25.78 | 0.69 |
| 20-24 | 12.89 | 7.16 |
| 25-29 | 3.56 | 10.62 |
| 30-34 | 0.00 | 12.47 |
| 35-39 | 0.44 | 14.55 |
| 40-44 | 1.33 | 12.24 |
| 45-49 | 0.89 | 8.31 |
| 50-54 | 0.00 | 8.55 |
| 55-59 | 0.44 | 3.93 |
| 60-64 | 0.00 | 6.24 |
| 65+ | 0.00 | 6.70 |
| Total | 100 | 100 |

(b) Education level for HH heads and spouses

Majority of the household heads within the project area have attained basic primary education as reflected in the Table 3-20. Only 10% and 9.52% of the household head and their spouses respectively have not attained any basic formal education. The analysis also found out that transition to tertiary education is low with only 3.75% and no spouse transitioned to tertiary level of education.

Table 3-20: Level of education for the household head

| Level of education | Household Head Population | Spouse of the Household Head |
|--------------------|---------------------------|------------------------------|
| None | 10.00 | 9.52 |
| Primary | 36.25 | 52.38 |
| Secondary | 35.00 | 38.10 |
| Tertiary | 15.00 | 0.00 |
| University | 3.75 | 0.00 |
| Other | 0.00 | 0.00 |
| Total | 100 | 100 |

To communicate and mobilise the community effectively during implementation of the project, the project implementation team should adopt communication strategies that will be understood by the non-educated and the educated members of the community. These mobilization strategies include, public meetings conducted or translated in the local language, radio adverts in the local language and posters posted in the accessible public places in both Swahili and Local languages.

3.3.5 Housing conditions

Characteristics of housing for the PAPs were assessed in terms of roofing, walls and floor to determine the quality of housing available for the use within the community as shown in Table 3-21.

Table 3-21 Housing quality

| Roofing | |
|------------------------|--------------------------------|
| Type of Roofing | Percentage distribution |
| Corrugated Iron Sheets | 96.24 |
| Thatched | 2.26 |
| Tiles | 1.50 |
| Walls | |
| Type of walls | Percentage distribution |
| Wood | 66.92 |
| Stone | 25.56 |
| Mud | 4.51 |
| Bricks | 3.01 |
| Floor | |
| Type of floor | Percentage distribution |
| Earth | 57.14 |
| Cement | 42.86 |

3.3.6 Access to water

The County at large and project area are supplied by several water schemes. At the County level, there are 27 water supply schemes while at the project area most of the water supply schemes are managed by community members through water project committees. The water projects source their water from River Maragua and Irati. The two main existing water supply schemes in the project area are Gathaini Water Project and Karura Water Project.

The study established that majority (77.44%) of the community members have piped water system to their homesteads. This is supplemented by rainwater catchment which accounted for 69.17% of community's water source as indicated in Table 3-22.

Table 3-22: Water Sources

| Water Source | Percentage distribution |
|---------------------|--------------------------------|
| Piped to homestead | 77.44 |
| Rainwater | 69.17 |
| River | 25.56 |
| Springs | 8.27 |
| Shallow well | 4.51 |
| Borehole | 2.26 |
| Other Water Sources | 1.50 |
| Piped to community | 0.75 |

A majority (84.21%) of the community members take less than 30 minutes to and from water points with only 3.01% of those surveyed taking more than one hour. This is owed to the fact that most members of the community use piped water or collect rainwater for domestic use.

3.3.7 Water treatment and sanitation

Households use different purification strategies to make water safe for consumption. The most common method for treating water for domestic consumption in the surveyed population is boiling followed by chlorination. The percentage of persons who do treat their water is relatively high compared to those who do not. This can be a contributing factor to low reported cases of diarrhoea within the project area (survey results showed a prevalence rate of 13.53%).

Table 3-23: Water treatment methods

| Treatment method | Percentage distribution |
|------------------|-------------------------|
| Boil | 60.15 |
| Chlorinate | 29.32 |
| Nothing | 18.80 |
| Stand and settle | 8.27 |
| Other methods | 3.01 |
| Don't Know | 1.50 |
| Strain | 0.75 |
| Filtrate | 0.75 |

It is estimated that about 93.23% of the persons in the project area use pit latrines. This is followed by the usage in flush toilets which accounted for 4.51% of the surveyed population. The figure of persons having access to sanitation facilities is higher than the national average of 87.8 per cent.

3.3.8 Health conditions

Two data sources were used to get information on morbidity in the project area; namely the household level data on lay reporting of illness and the second data source was from the public health officers. Table 3-24 shows top ten (10) most prevalent diseases according reported cases at the Public Health Offices in Kangema and Kigumo:

Table 3-24: Disease prevalence according to PHO records

| Kangema | | Kigumo | |
|---------|-----------------------------------|--------|-----------------------------------|
| No | Most prevalent illness | No | Most prevalent illness |
| 1 | Upper respiratory tract infection | 1 | Upper respiratory tract infection |
| 2 | Skin disorders | 2 | Skin disorders |
| 3 | Pneumonia | 3 | Hypertension |
| 4 | Diarrhoea | 4 | Intestinal worms |
| 5 | Urinary tract infection | 5 | Injuries / accidents |
| 6 | Normal accidents | 6 | Pneumonia |
| 7 | Chicken pox | 7 | Diabetes |
| 8 | Eye infections | 8 | Diarrhoea |
| 9 | Rheumatism | 9 | Arthritis |
| 10 | Ear infections | 10 | Gastroenteritis |

From the field study, illness characteristics or symptoms were established. Table 3-25 shows the responses to a question regarding illnesses during the last four month period prior to the survey. These symptoms were therefore matched with records of diseases from the health facilities. Common cold was the most frequently made complaint accounting for about 88.72% of all cases. This was followed by complaints of Upper respiratory tract infection, Headache and worm infestation. The figures confirm findings from the health facilities that morbidity patterns are dominated by Upper Respiratory Tract Infections (URTIs), skin disorder, Pneumonia and Diarrhoea.

Table 3-25: Health problem cases

| Illness | Percentage distribution |
|-----------------------------------|--------------------------------|
| Common cold | 88.72 |
| Upper respiratory tract infection | 27.07 |
| Headache | 19.55 |
| Worms | 19.55 |
| Eye infections | 15.04 |
| Diarrhea | 13.53 |
| Other Illnesses | 12.78 |
| Skin infection | 10.53 |
| Tuberculosis | 0.75 |
| Jigger infestation | 0.00 |

From the consultations it was also noted that the HIV/AIDs prevalence cases in Kigumo and Kangema Sub-Counties covered by the project are 5.2% and 5.6% respectively. The most vulnerable groups within Kigumo were noted to be youth between the ages of 15 to 24 years and persons between the ages of 33 to 44 years. On the other hand, the most vulnerable group to HIV/AIDs in Kangema were noted to be persons within the ages of 12 to 24 years of age. The health offices within the two Sub-counties have put in place the following initiatives to combat medical condition:

- Use of community based organizations to support orphan and vulnerable children;
- Provision of HIV/AIDs counselling and testing services; and
- Health education to people living with HIV/AIDs

3.3.9 Medical facilities

Information of the available health facilities were obtained from the District Public Health Officers in the two Sub-Counties hosting the project. It was noted that Kangema has 13 healthy facilities categorised as follows:

- Sub-District Hospital 1
- Health Centres 4
- Dispensaries 8

Within the project nucleus in Ichichi location there is only one (1) dispensary. In Kigumo Sub-County there are 18 medical facilities categorised as follows:

| Division | Category | No. Of facilities |
|-----------------|--------------------------|--------------------------|
| Kinyona | Health Center | 1 |
| | Dispensaries | 7 |
| | Faithbased organization | 3 |
| Kigumo | Sub-county hospital | 1 |
| | Health Center | 1 |
| | Dispensary | 1 |
| Muthithi | Health Center | 1 |
| | Dispensary | 3 |
| | Faith Based Organization | 1 |

The biggest challenge that the sub counties in the project area face with regard to health is shortage of doctors. Within Kangema there are only four (4) doctors serving a total of 76,988 persons according to the 2009 Census. This translates to a doctor patient ratio of 1:19247. While in Kigumo there are only 2 doctors serving a population of 123,766 which translates to a

doctor patient ratio of 2:61883. The main referral hospital for the two Sub-Counties is Muranga District Hospital.

3.3.10 Gender issues

Table 3-26 below illustrates that the community is largely dominated by males in major household decision making. Gender imbalances still exist in decision making, resource control, and production processes mainly due to very strong traditional/cultural beliefs and practices. For instance, household heads will make decisions on family income, crop and animals to be sold as well as when to take children to school.

Women are usually left out of many development initiatives, and the perception exists that women's reproductive and domestic responsibilities should be their primary function. Women and girls are not encouraged to access education, by being forced to early marriages. This in turn excludes them in decision making and as a result lack of access to income and other means of production as well as being discriminated against in property ownership and inheritance.

From Table 3-26 and Table 3-27 below men own and control all family resources but labour is mostly provided by women and girls except for livestock rearing. Work load in the families within the project area is on women and girls.

Table 3-26: Gender roles

| Resources | Men | Woman | Boy | Girls |
|-----------------------|----------|----------|----------|----------|
| Digging | √ | √ | √ | √ |
| Cooking | X | √ | X | √ |
| Food collection | X | √ | X | √ |
| Vegetable collection | X | √ | X | √ |
| Fetching water | X | √ | X | √ |
| Washing utensils | X | √ | X | √ |
| Collecting firewood | X | √ | X | √ |
| Looking after animals | √ | √ | X | X |
| Washing clothes | X | √ | X | √ |
| Total task | 1 | 9 | 1 | 9 |

Table 3-27 showing access and control of resources in the project area was developed in consultation with the beneficiary community through small group meetings. From the Table, men own and control most of the household resources such as land, livestock, trees and other income generating properties.

Table 3-27: Resource control by gender

| Resources | Who buys | Who owns | Who controls | Who uses |
|--------------------------------|----------|----------|--------------|----------|
| Land | M | M | M | M/F |
| Trees and forest | M | M | M | F |
| Livestock | M | M | M | M/F |
| Household property | F | F | F | F |
| Cars, motorcycle and bicycles | M | M | M | M |
| Livestock – small e.g. chicken | F | F | F | F |
| Subsistence crops | M/F | M/F | F | F |

3.3.11 Community problems

From the socioeconomic survey, the biggest problem identified by the community is youth unemployment. During the stakeholder consultations, the community members requested that the proposed project should alleviate unemployment issues by absorbing bulk of the youth in the local area to work in its construction and operation stages. The second issue concern to the community is poor road infrastructure in the area which has caused a hindrance in tea transportation which is a key income generating activity. The community requested during the public consultation meetings that AWSB and the contractor improve the roads before construction works of the tunnel commences.

Projected increase in population in the project area following the commencement of the proposed project could aggravate the problem of lack of sufficient health facilities which was also noted by 42.11% of the population as a problem. This is supported by the notable deficiency in medical facilities presented in Section 3.3.9 of this report.

Table 3-28: Community problems

| Community problem | Percentage response |
|---------------------------|----------------------------|
| Youth unemployment | 80.45 |
| Poor Infrastructure | 61.65 |
| Lack of health facilities | 42.11 |
| Lack of land | 33.83 |
| Land slides | 28.57 |
| Water scarcity | 21.05 |
| Lack schools | 14.29 |
| Insecurity | 10.53 |
| Floods | 6.77 |
| Other unmentioned | 3.03 |

3.4 Economic Characteristics

The main economic activity within the project area is agricultural production. According to the County Development Plan approximately 57% of the population source their livelihood from agriculture. Of the above population, a majority grow cash crops. The major cash crops in the project area include tea and coffee. Horticultural crops which are grow at a small scale include tomatoes, cabbages, kales, spinach and French beans while food crops include maize, beans, bananas, sweet potatoes and cassava.

3.4.1 Employment status of persons living in the project area

A survey conducted by GIBB in October 2014 established that persons who are informally employed accounted for the majority of the surveyed population at 61.70%. Formal employment on the other hand accounted only for 10.30% of the surveyed population. This points to the fact that in case the project implementation team could require persons to be employed on informal wage basis, they will be readily available.

3.4.2 Income sources

The main income source for the community living in the project area is farming (Table 3-29). This accounted for 35.87% of the primary sources of income and 7.14% of the secondary source of income. Agricultural production in the project area is mainly rain fed with most people producing tea.

Table 3-29: Income sources

| Primary Income | Percentage distribution | Secondary Income | % distribution |
|-------------------|-------------------------|-------------------|----------------|
| None | 39.51 | None | 80.40 |
| Farming | 35.87 | Farming | 7.14 |
| Trading | 8.36 | Trading | 1.67 |
| Salaried | 9.88 | Salaried | 1.22 |
| Farm | 3.04 | Farm | 2.89 |
| Construction work | 1.06 | Construction work | 0.61 |
| N/A | 2.13 | N/A | 5.78 |
| Others | 0.15 | Others | 0.30 |
| Total | 100.00 | Total | 100.00 |

3.4.3 Land tenure and ownership

Land tenure in Kenya is classified into three categories, namely; – public land, community land and private land. Table 3-30 below shows that the most common land tenure system in the project area is private holding at 96.99%.

Table 3-30: Land tenure system

| Tenure system | Percentage distribution |
|----------------|-------------------------|
| Private Land | 96.99 |
| Public Land | 2.26 |
| Community Land | 0.75 |
| Total | 100.00 |

Respondents were asked whether they were the owners of land where they are currently staying. 97.74% of the respondents own land where they reside. Land tenants were notably few as presented in Table 3-31 below.

Table 3-31: Land ownership status

| Ownership category | Percentage distribution |
|--------------------|-------------------------|
| Land Owner | 97.74 |
| Tenant | 1.50 |
| Squatter | 0.75 |
| Total | 100.00 |

3.4.4 Land use potential and agricultural activities

The two sub-counties within the project area fall in Agro Ecological Zone UHO (forest reserve), UH1 (sheep dairy zone), LH1 (tea-dairy zone), UM1 (coffee-tea zone), UM2 (main coffee zone), and UM3 (marginal coffee zone).

Table 3-32: Land use potential

| Agro ecological Zone | Potential land use | Current land use | Location |
|----------------------|---|---------------------------------------|----------|
| UHO | Forest zone | Forest zone | Kangema |
| UH1 | Peas, carrots, cabbage, potatoes, maize, pyrethrum, pears, plums | Carrots, cabbage, maize, pears, plums | Kangema |
| LH1 | Peas, cabbages, lettuce, carrots, kales, potatoes, tea, loquats, passion fruits, pyrethrum, plums, kikuyu grass | Tea, dairy, potatoes, Cut flower | Kangema |

| Agro ecological Zone | Potential land use | Current land use | Location |
|----------------------|--|---|-----------------|
| UM1 | Cabbages, kales, passion fruit, onion, tomatoes, tea, coffee, citrus, pineapples, maize, bananas, potatoes, pawpaw, yams, kikuyu grass, napier grass, sweet potatoes vines | Tea, coffee, dairy, maize, beans, poultry, potatoes | Kangema, Kigumo |
| UM2 | Coffee, loquats, maize, beans, potatoes, cabbages, kales, tomatoes, onions, bananas, avocados, passion fruits, pineapples, citrus, star grass, napier grass | Coffee-main, dairy, maize, beans, macadamia, bananas, poultry, avocado, cut flower. | Kangema, Kigumo |
| UM3 | Coffee, bananas, citrus, pawpaw, cassava, pigeon peas, maize, onion, cabbages, beans, pineapples, macadamia nuts, high grass savanna, napier, bana grass, sweet potatoes vines | Coffee (marginal), bananas, maize, beans, mangoes, french beans, tomatoes | Kangema, Kigumo |

Crops grown in the area include subsistence crops such as maize, beans and bananas while tea is the main cash crop. They also grow horticultural crops, such as kales, cabbages, tomatoes and onions and sell in the nearby urban centers. Livestock husbandry is also practiced within the project area whereby farmers keep cattle, goats/sheep, donkeys, pigs, chicken and pets including cats and dogs. Livestock provides meat, milk, eggs and a cash income.

3.4.5 Energy sources

Table 3-33 presents the source of energy used by households in the project area. Firewood was the main source of cooking fuel accounting for about 70.68% followed by charcoal (18.05%). Ranking third was Liquid Petroleum Gas (LPG) accounting for 11.28% of the responses. In terms of lighting, battery lamps were the most prevalent at 55.64%. This is closely followed by the population that use kerosene lamps.

Table 3-33: Cooking energy

| Cooking energy | Source | Percentage distribution |
|-----------------|----------------------|-------------------------|
| | Firewood | 70.68 |
| | Charcoal | 18.05 |
| | Liquid Petroleum Gas | 11.28 |
| Lighting energy | Source | Percentage distribution |
| | Battery Lamp | 55.64 |
| | Kerosene Lamp | 37.59 |
| | LPG Lamp | 3.76 |
| | Electricity | 2.26 |
| | Other sources | 0.75 |

An 11KVA power supply is available in the project area. In addition to trade centers and mainly rural homes, the line also serves a number of tea factories along the project area. However, from the above table, only 2.26% of the surveyed households use electricity for lighting. This may be attributed to the prevailing high electricity connection fee. Extension of the 11kVa supply lines to the specific project sites would be readily achievable.

3.4.6 Roads access

The proposed project area can be accessed from Gatanga-Ndakaini Dam Road and from Kangema town. Not all the roads are all weather since some sections of the road are tarmacked while others are graded earth roads and have sections in dilapidated conditions. Some sections are very steep but they are regularly maintained to facilitate transport of tea leaves from the buying centres to the tea factories serving the area namely Makomboki tea factory and Gacharage tea factory.

The project contractor will use the existing roads in the project area. However, new but very short access roads (less than 100m) to the proposed intakes, adit/shaft and outfalls will be required by the contractor.

4 PROJECT DESCRIPTION

4.1 Introduction

The Northern Collector Tunnel (NCT) Phase 1 is a proposed new raw water transfer tunnel along the eastern fringe of the Aberdare Conservation Area approximately 60km north of Nairobi. The tunnel project will transfer raw water through approximately 11.8km from intakes at the Maragua, Gikigie and Irati Rivers to an outlet at the Githika River near Makomboki trading centre, upstream of the existing Thika Reservoir. The intake points on these rivers are about 5km from the eastern edge of the Aberdare Conservation Area (see Figure 1-6). The principal features of the NCT Phase 1 include the following:

- River diversion weir and related intake hydraulic structures at Maragua River including:
 - 20m wide, 5m high weir including trench diversion intake
 - 37m long, 4m deep de-silting basin
 - Compensation channel
- River diversion weir and related intake hydraulic structures at Gikigie River including:
 - 14m wide, 3.3m high weir including trench diversion intake
 - 17m long, 2m deep de-silting basin
 - Compensation channel
- River diversion weir and related intake hydraulic structures at Irati River including:
 - 20m wide, 4.4m high weir including trench diversion intake
 - 25m long, 2m deep de-silting basin
 - Compensation channel
- Drop shaft and connection gallery connecting the Irati intake to the main tunnel
- River outlet at Githika River including:
 - Cut and cover portal outlet from the main tunnel
 - 20m long outfall stilling basin structure
- Main Northern Collector Tunnel Phase 1 (main tunnel) including portals, excavation, initial support and permanent concrete lining. The tunnel is approximately 11.8km long and of 3m finished internal diameter:
 - Connection adit from Githika tunnel to the main tunnel;
 - Drop Shaft and connection adit at the Irati intake;
 - Access gallery from Kaanja Valley to the main tunnel.

The design life specified for infrastructure civil works is typically in the range of 60 to 150 years although provisions for design life established in the British Standards (BS) vary from 60 to 120 years. Cognisant of the importance of the NCT tunnel as a critical element of infrastructure for water supply for the city of Nairobi, it is considered that the general guidance provided in BS 8500-1:2006 with respect to a design life of 100 years is suitable and applicable for the main tunnel and its associated permanent infrastructure elements.

4.1.1 River Diversion Weir and Intake Structures

Diversion and intake structures are to be constructed on three rivers namely Maragua, Gikigie and Irati, to divert 3m³/s, 1m³/s and 2m³/s respectively to the collector tunnel. The pertinent features of the river diversion and intake structures are listed below and presented in Figure 4-1.

1. A river diversion weir;
2. A trench intake with trash rack inlet inbuilt in the diversion weir;
3. A compensation channel for downstream flow;
4. A Desilting basin with hydraulic features for flow control, settling, silt flushing and weir outlet to the Collector Tunnel;

5. Pipeline transition to Collector Tunnel for the case of Maragua and Gikigie Intakes or Vertical shaft transition to Collector Tunnel for the case of Irati Intake; and
6. Flushing pipe for silt load deposited in desilting basin.

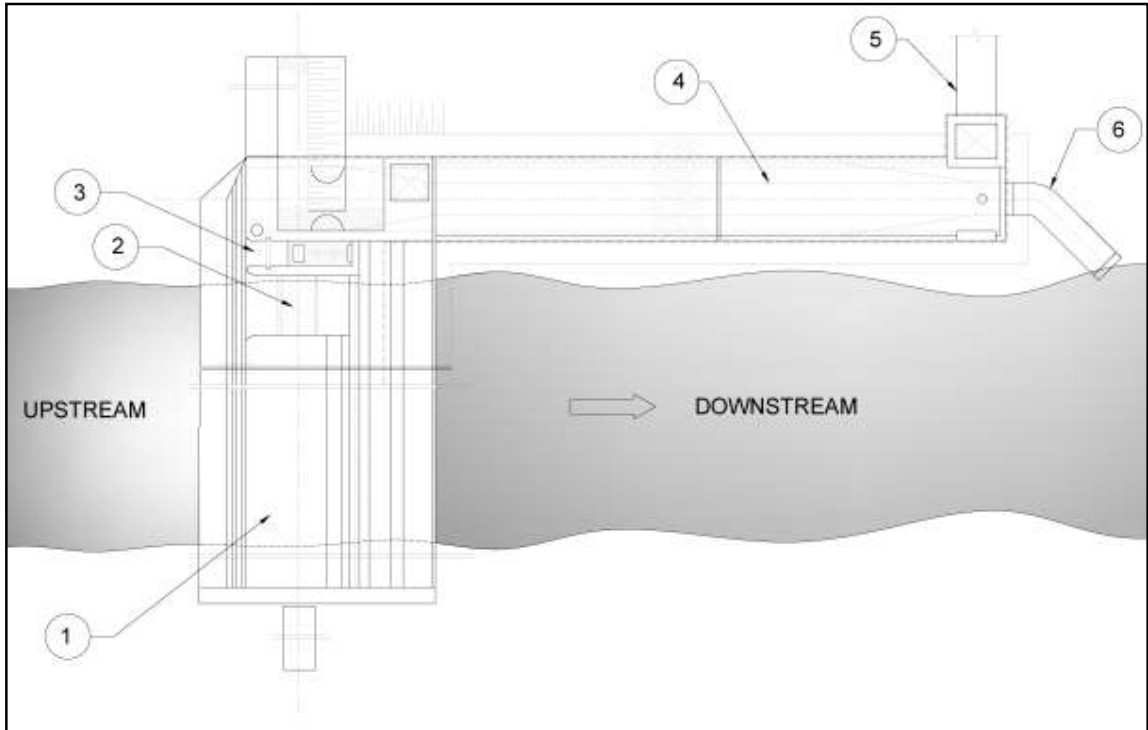


Figure 4-1: General arrangement of river diversion and intake facilities

(a) River Diversion Weirs

The diversion weirs will be ogee type with trench intake inbuilt in the body. The weir is required to have sufficient hydraulic capacity to release the excess of the diversion and compensation flows, up to the 1 in 100 year flood.

The weir height (P) and design head (Hd) are summarized in Table 2 below:

Table 4-1: Summary of weir height (P), discharge head (Hd) and weir length

| Parameter | Maragua Weir | Gikigie Weir | Irati Weir |
|---|--------------|--------------|------------|
| Maximum discharge head over weir during 1 in 100 year flood event, Hm (m) | 1.80 | 1.50 | 1.80 |
| Design head, Hd based on maximum H/Hd = 1.25, (m) | 1.44 | 1.20 | 1.44 |
| Weir crest height above river bed level, P (m) | 5.0 | 3.3 | 4.4 |
| Provided net length, L (m) | 20.00 | 14.000 | 20.00 |

River training and bank protection

Training walls are provided on the flanks of the weirs and are extended with gabion walls beyond the flip bucket lip to guide the flow into the river channel and protect the river banks. The desilting basin provides the required training wall on one bank while gabion walls are provided on the opposite river bank.

(b) Intake

A trashrack, consisting of heavy steel flats placed parallel with the river flow, is provided at the crest of the river diversion weir. Water while flowing over the diversion weir, passes through the trashrack and enters into a collection trench and the collected water then flows into a desilting basin before entering the tunnel conveyance system.

Hydraulic design of trench intake consist of fixing the dimension of the intake trash rack, trench and the disilting basin with hydraulic flow control facilities to ensure that only required amount of water is diverted to the collector tunnel and to minimize amount of silt going through the tunnel.

The above dimensions of the trashrack for Maragua, Gikigie and Irati intakes respectively are as in Table 4-2 below.

Table 4-2: Dimensions of intake trashrack

| Trench Intake location | Sloping Length of trash rack, L (m) | Inclination , (degrees) | Horizontal breadth of trench, W (m) | Width of trash rack, B (m) |
|-------------------------------|--|--------------------------------|--|-----------------------------------|
| Maragua | 1.870 | 27 | 1.700 | 5.600 |
| Gikigie | 1.342 | 27 | 1.300 | 2.900 |
| Irati | 1.625 | 27 | 1.500 | 4.500 |

(c) Desilting Basin

Desilting basin consists of an approach channels to the desilting basins. The dimensions of approach channels to desilting basins are summarized in Table 4-3 below.

Table 4-3: Dimensions of approach channels to desilting basins

| Intake location | Channel width from section 2.4.2 , B (m) | Water flow depth, h, from section 2.4.3 | Minimum Channel depth, $H=h+fb$ (m) | Channel slope (%) |
|------------------------|---|--|---|--------------------------|
| Maragua | 1.700 | 1.200 | 1.500 | 0.13% |
| Gikigie | 1.300 | 0.800 | 1.100 | 0.09% |
| Irati | 1.500 | 0.900 | 1.200 | 0.17% |

A flume section is provided in the approach channel to desilting basin, with a width-contraction created by semi-circular shoulders. The flume is solely width-contracted; sill-contraction is avoided as this would cause entrapment of the bed load being transported through the structure to the desilting basin. The flume is selected for the control section primarily due to the minimal head loss needed to maintain critical flow conditions in the throat of the flume, its adaptability to the channel configuration, and because it is economical to construct.

The desilting basin consists of the inlet, settling, outlet and sediment storage and flushing zones. The basin dimensions for removal 0.5 mm clayey sediments with least specific gravity are selected for conservative design as summarized in Table 4-4 below.

Table 4-4: Dimensions of desilting basins

| Intake location | Settling Zone | | | Sediment Storage and Flushing Zone | | | |
|-----------------|---------------|------------|-----------|------------------------------------|-------------------------|----------------------------------|--|
| | Length L (m) | Width B(m) | Depth (m) | Side slope of hopper section | Depth of hopper section | Diameter of flushing orifice (m) | Longitudinal slope of flushing channel (m) |
| Maragua | 27.0 | 2.7 | 3.3 | 50% | 0.45 | 0.80 | 5% |
| Gikigie | 16.0 | 1.5 | 1.9 | 50% | 0.23 | 0.50 | 5% |
| Irati | 22.0 | 2.2 | 2.2 | 50% | 0.35 | 0.60 | 5% |

(d) Tunnel Inlet Well Drop Structure

The clarified water from the desilting basin collector channel enters the tunnel through a well drop structure and a transition pipeline whose length depends on the distance to the tunnel portal. The selected dimensions and other key features of the well drop structure are summarized in Table 4-5 below.

Table 4-5: Design Features of Well Drop Structure

| Intake location | Inlet Weir Notch | | | Outlet Orifice | | Plunge pool depth, dp (m) |
|-----------------|---|----------------------|---|-------------------------|---|---------------------------|
| | Design Discharge, Q (m ³ /sec) | Length of weir B (m) | Head over weir at design discharge h1 (m) | Orifice diameter, D (m) | Head over orifice at design discharge, h2 (m) | |
| Maragua | 3 | 2.0 | 0.642 | 1.0 | 1.935 | 1.00 |
| Gikigie | 1 | 1.0 | 0.490 | 0.7 | 0.895 | 0.65 |
| Irati | 2 | 1.75 | 0.535 | 0.9 | 1.310 | 0.85 |

A transition pipeline connects the well drop structure to the Tunnel, discharging at the tunnel portal for the case of Maragua and Gikigie intakes and discharging into the drop shaft for the case of Irati Intake.

(e) Irati Drop Shaft

The vortex-flow drop shaft will be used for the project. The main hydraulic components include approach channel, inlet structure, drop shaft, de-aeration chamber and adit (connecting tunnel). The dimensions of the Irati shaft inlet structure is as shown in Table 4-6.

Table 4-6: Design calculations for Irati drop shaft inlet structure

| Parameter | Formula/assumption | Calculation result |
|-----------------------------------|--------------------|--------------------|
| Minimum dimensions (Hager, 1990): | | |
| Length, L (m) | $L = 5.3 ds$ | 5.46 |
| Width, W (m) | $W = 1.4 ds$ | 1.44 |
| Height, H (m) | $H = 2.15 ds$ | 2.22 |

The shaft is designed to be of circular section with 4000mm internal diameter and the total depth is approximately 55 m.

(f) Compensation Channels for In-stream Flow Requirements (IFR)**(i) Design features**

The compensation channels are designed to maintain at minimum the in-flow stream requirements. The inlet to compensation channel is provided beside the diversion intake at a lower sill elevation than the sill elevation of the diversion intake. Beyond the

inlet, the channel crosses above the diversion intake trench then runs beside the desilting basin, sloping down to the downstream river bed level at its outlet which coincides with the flushing end of the disilting basin.

The headworks consist of:

- A common inlet trashrack for intake trench and compensation channel is provided to exclude large floating materials, which roll through the slope of the trashrack to the downstream section;
- A slide gate to regulate flows above the minimum requirement for compensation flows;
- A stoplog gate between the inlet orifice and the slide gate orifice to isolate the slide gate and channel for inspections and maintenance;
- A level gauge for compensation flow measurement;

The compensation channel dimensions are summarized in Table 4-7 below.

Table 4-7: Design Features of Compensation Channel

| Name of Intake | Required minimum compensation flow, Q (m ³ /sec) | Width of channel, Bc (m) | Invert slope of inlet channel, S (%) | Required depth of compensation invert below intake trench invert level, (m) |
|----------------|---|--------------------------|--------------------------------------|---|
| Maragua | 0.645 | 1.0 | 0.2% | 0.645 |
| Gikigie | 0.100 | 0.6 | 0.2% | 0.273 |
| Irati | 0.481 | 0.8 | 0.2% | 0.481 |

An IFR of Q95 was adopted for both Maragua and Gikigie rivers. For Irati River, a variation of 1.4Q95 was adopted since Q95 was deemed to be inadequate to meet IFR.

(ii) Operating principle

The operational requirement of the compensation channel is considered in three phases as follows:

- At low river flows, i.e. not exceeding the required minimum compensation flow ($Q < Q_c$), the compensation channel gate is fully open and all flows are permitted through the compensation channel gate under free flow condition. The low flows are not permitted through the diversion intake until the required minimum compensation flow is satisfied;
- At higher river flows, i.e. exceeding required minimum compensation flows but excess not exceeding intake diversion capacity ($Q > Q_c$ and $Q - Q_c < Q_d$), the compensation channel gate is partially open to only permit the minimum compensation flow (Q_c) and divert the excess ($Q - Q_c$) to the tunnel intake. The head of water behind the compensation gate contribute to pressure flow through the gate orifice; and
- At river flows exceeding the required minimum compensation plus maximum diversion flows (i.e. $Q > Q_c + Q_d$), the compensation channel gate is fully closed. The excess of diverted flow (i.e. $Q - Q_d$) is passed to the downstream through the main overflow weir, and exceeds the required minimum compensation flow.

4.1.2 Northern Collector Tunnel

The water diverted from the intakes is conveyed through the NCT Phase 1 to an outfall on River Githika as per schematic arrangement shown in Figure 4-1 below.

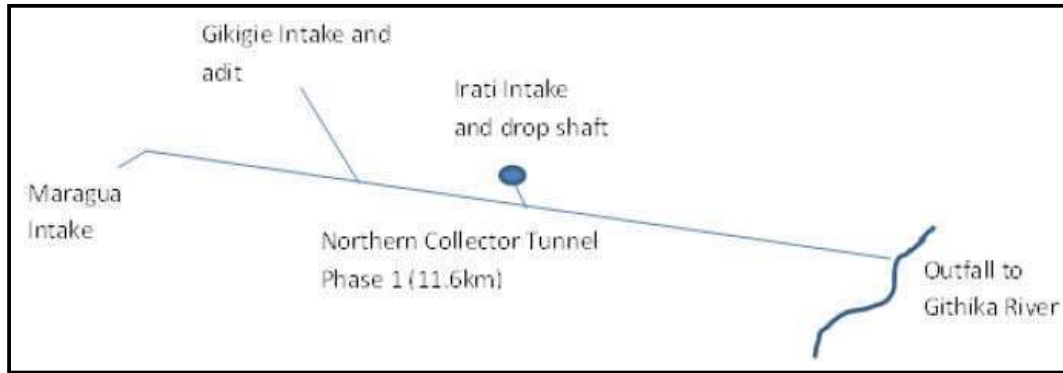


Figure 4-2: Schematic layout of Northern Collector Tunnel

The design data and assumptions for the tunnel are:

- Maximum flow at 0.8 of tunnel depth to maintain steady and uniform open channel flow at hydraulic conditions;
- Maximum velocity of 3m/s to minimize scour action; and
- Design flow =130% of required flow.

The tunnel flow is divided into three sections as summarised in Table 4-8.

Table 4-8: Tunnel design flows (m³/s)

| Tunnel Section | Required flow | 30% Contingency flow | Tunnel Design flow |
|-----------------|---------------|----------------------|--------------------|
| Maragua-Gikigie | 9 | 2.7 | 11.7 |
| Gikigie-Irati | 10 | 3 | 13 |
| Irati-Makomboki | 12 | 3.6 | 15.6 |

- Three lining conditions are considered: Rock, Shotcrete and Concrete.
- Tunnel invert slopes (Table 4-9) are based on surface elevations at the key points along the tunnel including Maragua Intake, Gikigie Intake, and Makomboki Outfall.

Table 4-9: Tunnel Slopes

| Tunnel Section | Length (m) | Upstream Invert Level (m.asl) | Downstream Invert Level (m.asl) | Tunnel slope (%) |
|-----------------------------------|------------|-------------------------------|---------------------------------|------------------|
| Maragua Intake to Gikigie Intake | 2,946 | 2070.00 | 2065.59 | 0.15% |
| Gikigie Intake to Irati Intake | 2,492 | 2065.59 | 2061.86 | 0.15% |
| Irati Intake to Makomboki Outfall | 6,252 | 2061.86 | 2052.50 | 0.15% |

- Tunnel shape: Both circular and horse shoe shape are considered for the tunnel section.
- Froude number is limited to $Fr \leq 0.8$ to maintain sub-critical flow conditions in the tunnel and hydraulic grade line (HGL) within the tunnel section.

The minimum tunnel diameter is considered to be 3m from constructability point of view. Based on the hydraulic, constructability and economic considerations, the recommended tunnel diameter of circular tunnel is 3m.

The horse-shoe shape of equivalent crown diameter would however be more preferred due to its higher hydraulic capacity than the circular shape. It also presents the advantage of being motorable for inspection and maintenance purposes, due to flatter and wider invert.

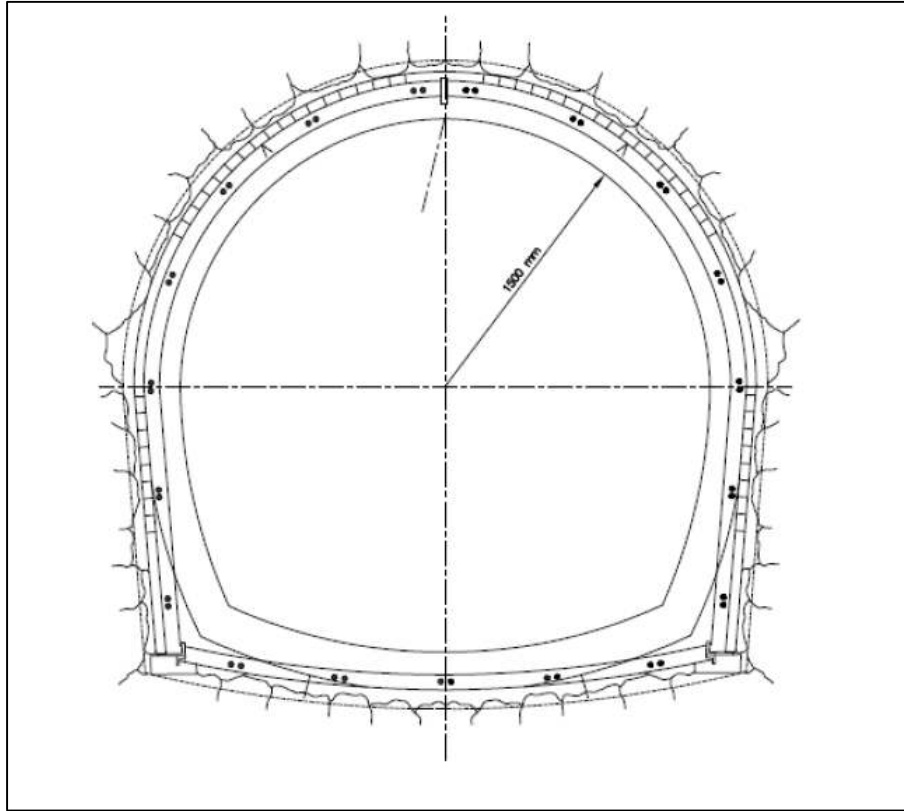


Figure 4-3: Typical horse-shoe tunnel section

4.1.3 Tunnel Outfall Structure

The outfall structure is located at the discharge end of the northern collector tunnel, where the tunnel flow joins the Githika River en route to Thika Dam. The outfall structure is provided to effectively dissipate the energy from the tunnel flow as the tunnel flow joins Githika River. This is achieved through a stilling basin. The stilling basin section is characterized by some combination of chute blocks, baffle blocks, and sills, designed to trigger a hydraulic jump in combination with a required tailwater condition.

Depending on the specific design, stilling basins operate over a range of approach flow Froude numbers from 1.7 to 17 as summarized in table below.

Table 4-10: Types of Stilling Basin

| Stilling Basin | Minimum Approach Froude Number | Maximum Approach Froude Number |
|----------------|--------------------------------|--------------------------------|
| USBR Type III | 4.5 | 17 |
| USBR Type IV | 2.5 | 4.5 |
| SAF | 1.7 | 17 |

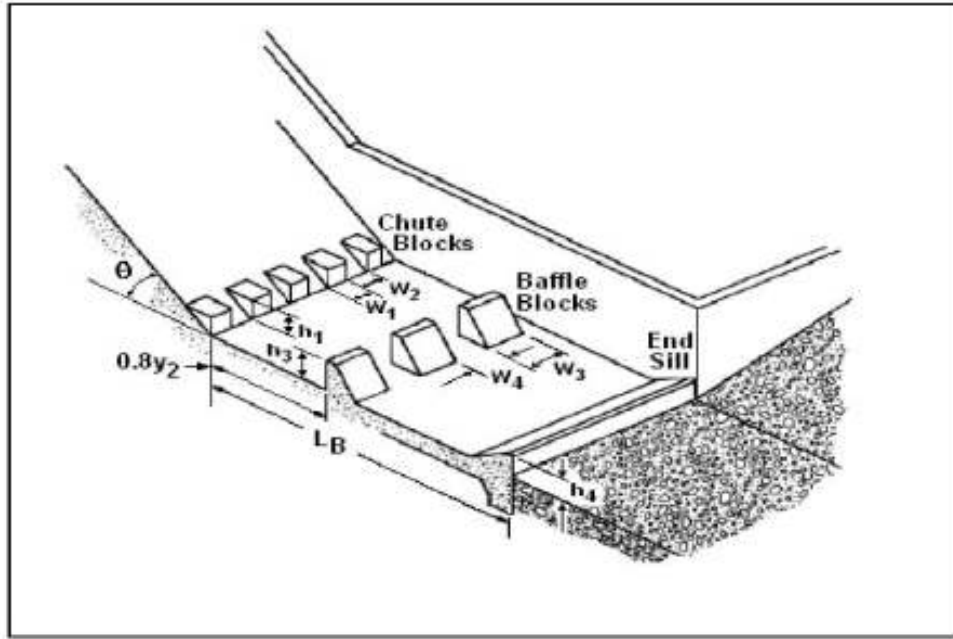


Figure 4-4: Definition sketch of USBR Type III stilling basin

4.1.4 Kaanja and Gikigie Adits

The Kaanja and the Gikigie adits provide access to the NCT tunnel alignment in two intermediate locations, allowing the simultaneous excavation of the tunnels in various fronts. The adits are assumed to have the same cross section as of the main tunnel, with the support type varying according to the geological conditions encountered during excavation.

Kanja access adit consists of temporary 750m long construction access decline at approximately 6.5% gradient (assuming portal at elevation 2116 maod and main tunnel at 2067 maod. Profile is nominally the same as the main collector tunnel to enable use of same support elements. Gikigie adit will transfer water from the Gikigie Intake to the main collector tunnel.

The adits are assumed to be excavated using the Conventional Tunnelling Method (CTM) as described in section 4.3.1 of this report.

4.1.5 Tunnel portals

Two main tunnel portals are considered at the north and south ends of the tunnels, at Maragua and Githika respectively. Tunnel portals will also be required for the Kaanja and Gikigie construction access tunnels.

Portal construction will commence with necessary cuttings and earthworks to form the slopes and provide a suitable worksite area from which the tunnel excavation can proceed.

It is expected that the two main portals will be located within residual soils. Therefore, excavations for portal slope formation are likely to require permanent slope stabilization support before tunnel excavation is achievable. Such portal excavations will be arranged as deepening trench excavations extending into the existing sloping topography allowing easy access to the portals for spoil removal and materials supply. It is expected that slopes will be stabilized by applying sprayed concrete to exposed surfaces. The thickness of sprayed concrete required will be probably between 150 to 200mm. Rock bolts and grouted bars may also need to be considered to achieve the required factor of safety against slope failure.

The initial tunnel support arrangement at portals will comprise the installation of canopy tubes at the crown, ahead of the excavation, followed by the erection of steel arch sets and shotcrete arch support to form a stiff support structure.

General tunnel drawings including the location, arrangement plan, tunnel adit and setout points, longitudinal section, diversion weir section, intake arrangement plan and site maps are presented in appendix I.

4.2 Fish Passes

Fish passes have been included in the design of weirs to enable upstream migration of Rainbow Trout (*Oncorhynchus mykiss*) and Brown Trout (*Salmo trutta*) for spawning purposes. The construction of weirs will impede free longitudinal passage through rivers by these aquatic organisms. The provision of fish passes, that support the interlinking of the river reaches, will make a real contribution towards sounder management of the rivers.

Technical fish passes include the following types: Pool passes, Vertical slot passes, Denil passes (counter flow passes), Eel ladders, Fish locks and Fish lifts. For this project, conventional pool passes have been adopted since their hydraulic and biological effectiveness have been adequately studied. The principle of a pool pass consists in dividing up a channel leading from the headwater to the tailwater by installing cross-walls to form a succession of stepped pools. The discharge is passed through openings in the cross-walls and the potential energy of the water is dissipated, step-by-step, in the pools. Fish migrate from one pool to the next through openings in the cross-walls that are situated at the bottom (submerged orifices) or at the top (notches). The migrating fish encounter high flow velocities only during their passage through the cross-walls, while the pools with their low flow velocities offer shelter and opportunities to rest. The fish pass channels are not covered over in order to allow daylight since diurnal fish avoid swimming into dark channels.

Table 4-11 summarizes the hydraulic design of the fish passes and schematic presentation is given in Figure 4-5.

Table 4-11: Summary of fish passes hydraulic design features

| Item | Parameter | Maragua Intake | Gikigie Intake | Irati Intake |
|--------------------------------------|---|----------------|----------------|--------------|
| 1. | Weir parameters | | | |
| | Highest headwater level, m.asl | 2079.67 | 2075.20 | 2114.25 |
| | Lowest tailwater level, m.asl | 2073.50 | 2071.50 | 2109.50 |
| | Maximum drop height, htot (m) | 6.17 | 3.70 | 4.75 |
| 2. | Pool Dimensions and hydraulics | | | |
| | Selected pool dimensions for Rainbow trout | | | |
| | Pool width, b (1.6 - 2.0 m) | 1.60 | 1.60 | 1.60 |
| | Minimum water depth, h (0.8 - 1.0 m) | 0.8 | 0.8 | 0.8 |
| | Length of pool, lb(2.5 - 3 m) | 2.5 | 2.5 | 2.5 |
| | Thickness of partition wall, d(m) | 0.15 | 0.15 | 0.15 |
| | The surface of the pool bottoms is roughened using river boulders | | | |
| | The cross-walls are to have bottom orifices, and top notches: | | | |
| Clear orifice span, bs (0.4 - 0.5 m) | 0.50 | 0.50 | 0.50 | |

| Item | Parameter | Maragua Intake | Gikigie Intake | Irati Intake |
|------|---|----------------|----------------|--------------|
| | Clear orifice height, h_s (0.3 - 0.4m) | 0.40 | 0.40 | 0.40 |
| | Width of notches, b_a (≥ 0.3 m) | 0.30 | 0.30 | 0.30 |
| | Height of notches, h_a (≥ 0.3 m) | 0.300 | 0.300 | 0.300 |
| | Water level difference in subsequent pools, Δh ($\Delta h_{max} = 0.2$ m) | 0.2 | 0.2 | 0.2 |
| | Mean water depth, $h_m = h + \Delta h / 2$ (m) | 0.900 | 0.900 | 0.900 |
| | Slope for pool pass, $I = \Delta h / l_b$ (%) | 8.0% | 8.0% | 8.0% |
| | Number of pools needed, $n = h_{tot} / \Delta h - 1$ | 30 | 17 | 23 |
| | Discharge through bottom orifice: | | | |
| | Flow velocity in orifices, $V_s = \sqrt{2g\Delta h}$ (m/s) | 1.98 | 1.98 | 1.98 |
| | Assumed discharge coefficient, Ψ (0.65 to 0.85) | 0.75 | 0.75 | 0.75 |
| | $Q_s = \Psi * A_s * V_s$ (m ³ /s) | 0.30 | 0.30 | 0.30 |
| | Discharge through top notch: | | | |
| | Difference in the water level between headwater and tailwater, $h_{weirhead} = \Delta h$ (m) | 0.20 | 0.20 | 0.20 |
| | Drowned-flow reduction factor, σ | 1.00 | 1.00 | 1.00 |
| | Assumed discharge coefficient, μ (0.6) | 0.60 | 0.60 | 0.60 |
| | $Q_a = 2/3 * \mu * \sigma * b_a * \sqrt{(2 * g) * h_{weirhead}}^{1.5}$ (m ³ /s) | 0.05 | 0.05 | 0.05 |
| | Total discharge through pool pass, $Q = Q_s + Q_a$ (m ³ /s) | 0.34 | 0.34 | 0.34 |
| | Check: is recommended discharge through fish pass obtained, Q_{rec} (0.2 - 0.5 m ³ /s) | OK | OK | OK |
| | Power density, $E = \rho * g * \Delta h * Q / (b * h_m * (l_b - d))$ (W/m ³) | 200 | 200 | 200 |
| | Check: $E \leq 200$ W/m ³ ? | OK | OK | OK |

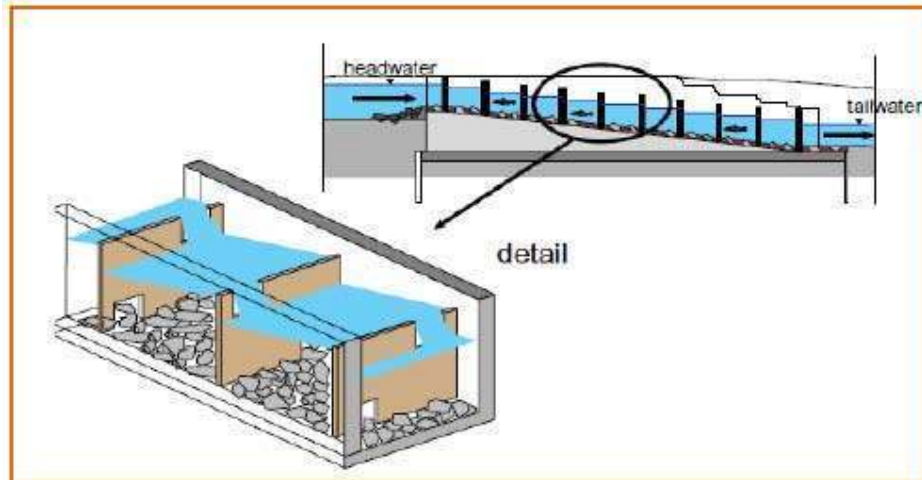


Figure 4-5: Conventional pool passes (longitudinal section and pool structure)

4.3 Tunnel Excavation Methods

Given the apparent variability in the ground types as well as the variability in the required rock support and the potential pre-support or pre-treatment of the rock, a combination of two methods of tunnel excavation along the proposed 11.8km tunnel alignment has been proposed. It is envisaged that the majority of the tunnel would be excavated by mechanised techniques (roadheader or excavator-type machines) with only a relatively small section of the tunnel requiring the use of drill-and-blast techniques when the harder basalts are intersected.

4.3.1 Conventional Tunnelling Construction

The Conventional Construction combines mechanized and drill and blast methods which are characterized for the generally shorter time and lower investment cost required for procurement of equipment and mobilization, due to the use of standard specialized equipment (provided that extensive preliminary works are not required). Major limitations are slow advance rates compared to Tunnelling Boring Machine (TBM) and the potentially excessive ground disturbance causing over-break and leading to more onerous temporary support measures required. The following excavation equipment are likely to be used for Conventional Tunnelling in the NCT Phase 1:

- Excavators with rock hammers and buckets for completely weathered and highly weathered rock up to around 10 MPa strength;
- Roadheader or milling heads on modified excavators for weak to medium strength rock (1 MPa to 30 MPa strength);
- Drill and Blast for medium to strong rock (around 15 MPa or more).

Initial support for the excavations would be shotcrete and rockbolts for better rock conditions ranging up to steel rib support for weaker ground. Pre-support of the face with fore-poling and face nailing may be required in the weaker ground types.

4.3.2 Excavation by Tunnelling Boring Machine (TBM)

For this project the use of a TBM will have some inherent advantages over other forms of excavation. The tunnel excavation advance rates are high for this form of tunnelling when compared to other methods of construction. Furthermore, a high quality circular excavated profile can be achieved. Unlike with drill and blast techniques, there is minimal deterioration of the rock mass quality in the tunnel periphery following excavation. Also, when compared with a horseshoe profile, a circular shape is more economical in terms of the production and removal of spoil.

Concerning tunnel support, a segmental lining can be conveniently erected to provide support to the excavated profile. By using a TBM the segmental lining can be erected behind the TBM in cycles as it advances forward so that the possible need for rock bolting and shotcrete is avoided. Thus eliminating or at least minimising, temporary rock support requirements along the alignment.

The principal disadvantage of the adoption of TBM tunnelling for this project is the time required for the purchase and delivery of equipment. Such delivery time could be between 6 months and a year depending on the availability of used equipment or the purchase of a new machine. Depending on the programming of the tunnel construction, such a delay may not present any problems to overall delivery of the project.

4.4 Material Sources and Spoil Sites

4.4.1 Material Sources

Construction materials such as stone blocks and coarse aggregates are not readily available in the area due to the significant weathering depth in the local volcanic geology. Most rocks are located in the valley bottoms. These valley bottoms are not accessible due to the steep terrains in the region. Small quarries are available near bridges at the river crossings which cannot meet the construction material demand in the region. The bulk of the materials are normally sourced outside the project area. The following construction materials may be locally obtainable:

- **Building Stone and aggregate:** There appears to be ample suitable sources of aggregate for concrete works in Kijabe area (some 35km south west of the project area), and scarce in the Muranga (Fort Hall) and Nyeri areas where overburdens are stated to be very thick (i.e. the sub-counties to the east and north of the project area). Although materials available in the Kijabe and Nyeri areas, it is not easy to travel across the valleys and ridges. The pattern of travel is parallel to the ridges/valleys. Most of the roads are located on the ridge tops which are dictated by the terrain. The bulk of the construction stone blocks and coarse aggregates are sourced from existing/licensed quarries near Thika town and Makuyu, approximately 50 to 100 kilometres from the project location.
- **Clays** are expected to be readily obtainable, volcanic rocks exposed to tropical weathering generally decompose to give rise to thick profiles of clayey (normally red) residual soils. These are not expected to be of much practical use for this project. But have been investigated and used for the clay core of a nearby dam.
- **Sands** are the predominant weathering product from volcanic rocks, it can be expected that sands will be difficult to source in an area characterised exclusively with volcanic deposits. The bulk of the fine aggregates used are sands from rivers in Machakos County which are approximately 100 to 200 kilometres from the project area.

4.4.2 Spoil sites

Some 250,000 cubic meters of material will be excavated from the tunnel. Due to the anticipated weathered nature of the rock to be excavated, much of this may not be suitable. Additionally this material may deteriorate over time. It is important that the materials testing be conducted on the tunnel material in order to determine its suitability for reuse e.g. in the rehabilitation and maintenance of roads, and to reduce the land required to dispose of the spoil. It is likely that the spoil from the tunnel may be readily absorbed in the area. Six spoil sites have been proposed by the design consultant and they are as shown in Table 4-12.

Table 4-12: Details of proposed spoil sites

| Spoil No. | Location | Jurisdiction | Owner (s) | Description |
|-----------|-------------------------|--|---|--|
| 1 | X= 260420 Y= 9923247 | Kiruri location, Kangema Sub-county | <ul style="list-style-type: none"> Ms Eunice Wanjiru | <ul style="list-style-type: none"> Site is next to Maragua River; Currently has tea plantations; Trees include eucalyptus and <i>Ocotea usambarensis</i> (Muthaiti). |
| 2 | X= 259797 Y= 9922705 | Ichichi location, Kigumo Sub-county | <ul style="list-style-type: none"> Mr. Elnaso Ms Wangoi Nderu | <ul style="list-style-type: none"> Site is at the boundary of Ichichi Primary; It is a steep slope with tea plantations; Trees include eucalyptus. |
| 3 | X= 260621 Y= 9922506 | Ichichi location, Kigumo Sub-county | <ul style="list-style-type: none"> Mr. Samuel Mugo Murumi | <ul style="list-style-type: none"> Site has tea and maize plantations; Trees include eucalyptus. |
| 4 | X= 259721 Y= 9921941 | Ichichi location, Kigumo Sub-county | <ul style="list-style-type: none"> Mr Francis Kehunyo Kihanga | <ul style="list-style-type: none"> Site has tea and maize plantations; Trees include eucalyptus and <i>Ficus natalensis</i> (Mugumo). |
| 5 | X= 259666 Y= 9920408 | Ichichi location, Kigumo Sub-county | <ul style="list-style-type: none"> Mr Dishon Nyamu | <ul style="list-style-type: none"> Land is bare with a few shrubs and eucalyptus trees; It is near Gikigie River intake point; Is in both sides of Mununga-Ichichi road. |
| 6 | X= 258861 Y= 9915415 | Kinyona location, Kigumo Sub-county | Owner not yet confirmed | <ul style="list-style-type: none"> Site in next to the proposed Kaanja access tunnel (adit); Site is very steep with wells at the valley bottom being used by the community; Presence of tea plantation and eucalyptus trees on site. |
| 7 | X= 259394 Y= 9911209 | Makomboki location, Kigumo Sub-county | <ul style="list-style-type: none"> Mr Ngachia | <ul style="list-style-type: none"> Site has tea plantations; Its next to Githika river and the proposed outfall at Makomboki; Trees include eucalyptus and riverine vegetation. |

4.5 Project Inspection and Maintenance

Inspection of the tunnel during its operational life will be undertaken at regular intervals. This is a critical requirement in order to achieve the recommended Design Life of 100 years. It is envisaged that the first inspection should be carried out after one year of operation, then after two years of operation, and then at intervals to be determined based on the results of the first two inspections. It is also advisable to inspect the tunnel following any major seismic events.

Operation of the tunnel will need to be stopped during inspection so the works shall be planned to be completed in the minimum possible time, taking into account activities such as system drainage and decontamination times before and after inspection respectively.

Adequate planning of inspection procedures are necessary to minimise the interruption to the water supply. Such planning is more critical in the unlikely event that some repair work is required. Planning of these inspections shall be compatible with the operational requirements of the Thika Reservoir. There should be no attempt to do any required repair work during an inspection.

4.6 Safety in Design

The project design has been developed to ensure a safe operational environment, as well as taking into consideration the safety of personnel and the general public during construction and maintenance of the works.

A summary of the key structural Safety in Design issues relevant to the hydromechanical works relating to inspection and maintenance include the following

- Stainless steel and galvanised steel have been used in the design to minimise the maintenance work;
- Gratings are fixed so that general public cannot lift them;
- Grating has been designed only for man access;
- Access platforms with handrails provided to service gates;
- Gates are with " Tee-Key" operating gear which will protect against vandalism; and
- Trash rack and coarse bar screen are fixed and welded so that it can be protected against vandalism.

4.7 Temporary and enabling works

The project contractor will be expected to undertake design, construction, maintenance and removal upon completion the following temporary and enabling works associated with the above permanent works including but not limited to:

- Improvement of local access roads and associated local bridges for the purposes of executing the works;
- Establishment of project sites including buildings, short access roads (to camp, adits, intakes and outfall) and services (water, sanitation, communication, power etc.) and security measures, including:
 - Administration site
 - Accommodation
 - Workshops and material storage areas as required to complete the Project works
 - Concrete and other material production facilities as required to complete the Project works
 - Construction work sites
- The establishment of borrow areas and spoil disposal sites at locations approved by the Owner including sediment control and re-seeding of disposal areas;
- Design and construction of required temporary excavations, river diversions and inundation protection (including tunnels);
- Infrastructure and equipment required for tunnel and shaft construction including ventilation, lighting, communication, transport and major tunnelling plant to suit the agreed construction methods.

4.8 Construction Inputs and activities

Numerous construction inputs will be involved in the project. The following provides a summary of key apparent inputs and activities.

4.8.1 Construction materials

- Ordinary Portland cement - bagged
- Ordinary Portland cement - bulk
- Fine aggregate
- Coarse aggregate
- Concrete mix at central batch plant characteristic strength 20 MPa, slump 80mm and maximum aggregate size 20mm
- Reinforcing steel
- Reinforcing fabric
- Structural steel
- Explosive - gelatine
- Explosive - ammonium nitrate

4.8.2 Construction equipment

| Equipment | Rating |
|-----------------------------|-----------------------|
| Bulldozers | 70kw-250kw |
| Hydraulic excavators | 10-24t |
| Mobile cranes | 30t to 50t max |
| Track type loader | 80kw |
| Concrete plant | 60t/hr |
| Air compressors | 5m ³ /min |
| Generator | 365kw |
| Vibrating roller | 8 t |
| Tipper trucks | 0-25t |
| Vibrating rollers | 8 -12 t |
| Three wheel steel roller | 10-15t |
| Tandem steel roller | 12t |
| Vibrating Plate Compactor | 0.4t |
| Jack hammer | 25kg |
| Pick -up truck | 1.7t |
| Crushing plant | 150t/hr |
| Concrete mixer | 15hp0.5m ³ |
| Concrete vibrator | 35-63 mm diameter |
| Self-propelled water tanker | 6,000l |
| Self-propelled fuel tanker | 6,000l |
| Water pump centrifugal | 50 mm diameter |

4.8.3 Labour

Both skilled and unskilled labour will have input of substantial man hours in providing technical supervision and mechanical operation. The input for non-technical staff has been estimated at 4,100 man hours.

4.8.4 Construction activities (summary)

The project construction activities are summarised as follows

(a) For the intakes and outfall

- Temporary river diversion, water control and pollution control;
- Open-cut excavation and earthworks;
- Protection and support of open-cut excavations;
- Drainage;
- Concrete production and construction;
- Structural steelwork;
- Miscellaneous metalwork;
- Road and bridgeworks;
- Hydromechanical works; and
- Miscellaneous construction.

(b) For the tunnels and adits

- Open-cut excavation and earthworks;
- Protection and support of open-cut excavations;
- Underground excavation, protection and support of underground excavation;
- Drilling and grouting in tunnels;
- Structural steelwork and miscellaneous metalworks;
- Concrete production and construction, precast concrete and prestressed concrete; and
- Instrumentation.

4.9 Project Cost and Duration

The project is expected to cost approximately KES 6.8 Billion. The construction duration for the four options is as detailed in Table 4-13. The preferred option which is option 1 is estimated to take 39 months \pm 20%.

Table 4-13: Estimated construction duration for various methods

| Option | Program Duration Estimate |
|---|---------------------------|
| Option 1 – Conventional tunneling with 6 drives | 39 months \pm 20% |
| Option 2 – Conventional tunneling with 8 drives | 32 months \pm 20% |
| Option 3 – TBM Tunnel full length | 40 months \pm 20% |
| Option 4 – Hybrid 4 conventional drives + TBM | 32 months \pm 20% |

4.10 Community Support Projects

4.10.1 Community water projects

As part of giving back to the community from where it is drawing its water supplies, AWSB has strategy to address the water needs of the communities living along and downstream of the proposed Northern Collector Tunnel Phase 1. This will complement the efforts of Tana Water Services Board (TWSB) in provision of water to these communities. This will see the Murang'a communities benefit from development of water projects to the tune of Ksh. 1.270 billion. The key projects to be developed under this arrangement include:

- Muranga W/S (augmentation) – KSh. 800 Million;

- Gatanga W/S (augmentation) - KSh. 300 Million; and
- Gatango W/S (augmentation) – KSh. 170 Million.

Details of the above projects are presented in Table 4-14.

Table 4-14: Water projects to be supported by AWSB

| Muranga W/S (augmentation) | | |
|--|--|---|
| Project/component | Estimated number of beneficiaries | Area covered |
| Muruka–Kenol-Makuyu Pipeline – 34Km | 124,000 | Muruka Location, Kenol, Makuyu Location, Kabati Sub-location, Gitura Sub-location |
| Mareira-Sabasaba-Muthithi – 16.5Km | 46,000 | Maragwa Town, Kaharati and Kahumbu locations |
| Kaharati-Iganjo Pipeline – 6.5Km | 5,000 | From Kaharati to Kamahuha location |
| Rwathia - Mukangu pipeline – 27Km | | Wethaga, Gitie, Kahuti and the surrounding areas |
| Kayahwe – Kambirwa Pipeline – 12Km | 15,000 | Kambirwa Market, Itaru-ini area (by Sagana River), Mirira & Muthigiriri Market |
| Kahuti II Water Treatment Plant – 4,000m ³ /day | Estimates unavailable | Waithaga, Kianderi, Kahuti and another line to serve Mukangu, Gatheru and Gitige |
| Kiriciungu Water Treatment Plant – 4,000m ³ /day | 40,000 | Kandara town/ Ruchu location |
| Gatango Water Supply Project | | |
| Gatango intake in the North Mathioya River, laying of 30km of pipelines | Estimates unavailable | Kiru, Kamacharia and Gatari divisions of Mathioya sub county |
| Gatanga Water Supply | | |
| Extension of 8 km 8” pipeline from Karangi to Ndakaini | 30,000 | Wanduhi, Kiriaini, thare & Mureke |
| Chomo, Gatura Intakes and Rwagetha Treatment works (3000m ³ /day) | | Kigio, Gakurari, Kirwara, Gatanga, Mabanda and Gatunyu |
| Treatment works at Karangi (3000m ³ /day) | | Mbugiti, Gatura, Chomo, Rwegetha |

Muranga Water Supply contract has been awarded while bids for Gatanga Water Supply are being evaluated. The projects construction period for each is 18 months.

4.10.2 Corporate Social Responsibility

As part of CSR, AWSB has implemented the following projects for Gatanga Community Water and Sanitation company area:

- Kiama river intake and laying of 5km, 10 inch pipeline to serve Kariara and Kiriani wards
- Rehabilitated Kimakia Supply System serving Kariara, Parts of Kiaraini, mugumoini, and Gatanga
- Kiunyu Secondary School Borehole serving the school and the surrounding areas (Appr. 300 persons)
- AWSB has overseen the implementation of over 20 VIP latrines and Urine Diverting Dry Toilets (UDDTs) in Muranga county under a program financed by WSTF;
- AWSB has also drilled and developed 5 boreholes in Ithanga area (Ngelelya, Giathanini, Kinyangi and Greystone) this serves approximately 10,000 persons

While undertaking the Northern Collector Tunnel project, AWSB will carry out the following CRS activities:

- Engage Murang'a University in project activities like geotechnical investigation and supervision of specialized works;
- Construct a dispensary for the project which will be available for the community; and
- Ensure roads are maintained during construction.

ESIA for the community support projects will however be conducted under separate studies and are thus not considered under this study.

5 PROJECT ALTERNATIVES

An ESIA should identify and assess alternatives to the proposed project. Only the best alternative should be selected based on less negative impacts and cost-benefit analysis. An important alternative to be analysed is the “no project” alternative. This is a very important analysis because it helps the proponents measure the impacts from the project against those which would have taken place without the project.

5.1 No Project Alternative

The no-action alternative is often defined by the baseline information and is crucial in the assessment of impact because other alternatives are weighed with reference to it. This alternative would mean that the project does not proceed.

Without the project, the environmental situation will neither improve nor can we say that it will necessarily deteriorate. Development of the project on the other hand will ensure adequate water supply to the residents of Nairobi and 13 satellite towns namely Kikuyu, Ruiru-Juja, Kiambu, Karuri, Githunguri, Mavoko Municipality, Ngong Township, Ongata-Rongai, Thika, Gatundu, Limuru, Lari and Tala-Kangundo.

The no-projection option will however mean that the targeted populations will continue to suffer from inadequate and unreliable water supply. This also means that the local communities will potentially miss out on development opportunities that the project could bring including access to water and economic opportunities through project construction and operation including employment and small business opportunities.

This scenario is therefore not acceptable on either social or environmental grounds and not comparable with the project proposal.

5.2 Construction of Maragua Dam

Construction of Maragua dam had been proposed within the NCT study area i.e. at Kangema, Kigumo and Kahuro sub-counties at the confluence of Maragua and Gikigie rivers. The proposed dam was an embankment dam with a maximum height of 100m. The reservoir was projected to cover an area of 4km² and was to impound 100hm³ at its Normal Water Level (NWL). In addition to storing flood flow from the Maragua and Gikigie Rivers, a transfer tunnel had been proposed to transfer water from South Mathioya River to the dam. The length of this tunnel was to be approximately 3km.

According to ESIA Study report for the proposed Maragua dam finalized in January 2012 by Tertiary Consulting Engineers, the key environmental and socioeconomic impacts included:

- Substantial loss of agricultural land to the required reservoir area of 4km². There was no estimate for the number of households affected but the estimated cost of RAP was Ksh 6.6 billion;
- Total exclusion of future land uses in the affected area;
- Reduction of biodiversity by blocking migration of certain organisms and loss of habitats. However, no species of conservation significance were highlighted in the report;
- Dangers of people drowning either accidentally or intentionally;
- Spread of water borne diseases;
- Economically, the dam development required a capital outlay estimated to be about Kenya Shillings fifty nine billion ninety three million four seventy eight thousand nine

hundred and sixty six shillings (Kshs. 59,093,478,966.00). The implementation period was to be spread over three calendar years.

This option was hence considered to have greatest socioeconomic impacts from displacement and resettlement of numerous households, substantive acquisition of land and associated infrastructure in addition to the expensive capital outlay (more than eight times the cost of tunnel construction). This was therefore considered expensive and the Northern Collector Tunnel option was preferred.

5.3 Tunnel Construction Options

Alternative tunnel construction methods were made during the design stage. Tunnel construction alternatives that were identified as feasible are summarised below:

- Option 1: Conventional Tunnelling with 6 faces (Preliminary Design);
- Option 2: Conventional Tunnelling with 8 faces (additional access adit and up and down drives from Irati);
- Option 3: Single Tunnel Boring Machine (TBM) for complete tunnel;
- Option 4: Hybrid TBM and Conventional Tunnelling with 4 faces.

5.3.1 Conventional Tunneling construction

The Conventional tunneling Construction combines mechanized and drill and blast methods which are characterized for the generally shorter time and lower investment cost required for procurement of equipment and mobilization, due to the use of standard specialized equipment (provided that extensive preliminary works are not required). Major limitations are slow advance rates (compared to TBM) and the potentially excessive ground disturbance causing over-break and leading to more onerous temporary support measures required.

The following excavation equipment are likely to be used for Conventional Tunnelling in the NCT Phase 1:

- Excavators with rock hammers and buckets for completely weathered and highly weathered rock up to around 10 MPa strength;
- Roadheader or milling heads on modified excavators for weak to medium strength rock (1 MPa to 30 MPa strength);
- Drill and Blast for medium to strong rock (around 15 MPa or more).

Initial support for the excavations would be shotcrete and rockbolts for better rock conditions ranging up to steel rib support for weaker ground. Pre-support of the face with fore-poling and face nailing may be required in the weaker ground types.

Due to the apparently extensive presence of highly fractured medium to weak rocks, it is considered that the majority of the alignment will be excavated using roadheader. Drill and Blast methods would only be applied when hard rock (basalt) is intersected. For the areas close to the portals, where completely weathered rocks and residual soils are present, the use of excavator-type machines will be most suitable.

5.3.2 Excavation by Tunnel Boring Machine (TBM)

For NCT1 the use of a TBM will have some inherent advantages over other forms of excavation. Broadly speaking tunnel excavation advance rates are high for this form of tunnelling when compared to other methods of construction. Furthermore, a high quality circular excavated profile can be achieved. Unlike with drill and blast techniques, there is minimal deterioration of the rock mass quality in the tunnel periphery following excavation. Also, when compared with a horseshoe profile, a circular shape is more economical in terms of the production and removal of spoil.

Concerning tunnel support, a segmental lining can be conveniently erected to provide support to the excavated profile. By using a TBM the segmental lining can be erected behind the TBM in cycles as it advances forward so that the possible need for rock bolting and shotcrete is avoided. Thus eliminating or at least minimising, temporary rock support requirements along the alignment.

The principal disadvantage of the adoption of TBM tunnelling for this project is the time required for the purchase and delivery of equipment. Such delivery time could be between 6 months and a year depending on the availability of used equipment or the purchase of a new machine. Depending on the programming of the tunnel construction, such a delay may not present any problems to overall delivery of the project.

The following costs and programme outputs were estimated for each option:

Table 5-1: Estimated Construction Cost and Duration for Various Methods

| Option | Cost Estimate | Program Duration Estimate |
|--|----------------------|----------------------------------|
| Option 1 – Conventional tunnelling with 6 drives | US\$130 Mill ±20% | 39 months ±20% |
| Option 2 – Conventional tunnelling with 8 drives | US\$134 Mill ±20% | 32 months ±20% |
| Option 3 – TBM Tunnel full length | US\$ 108 Mill ±20% | 40 months ±20% |
| Option 4 – Hybrid 4 conventional drives + TBM | US\$ 120 Mill ±20% | 32 months ±20% |

From the above comparisons and the assessment of project area baseline conditions (it is notable that the project area is landslide prone), tunnelling by TBM will be environmentally preferable due to the lesser ground disturbance causing of over-break.

The design of the main NCT Phase 1 has considered options for both Conventional Tunnelling and TBM tunnel construction. Option 1 has been assumed as the base design with Option 3 considered as an alternative.

6 PUBLIC CONSULTATIONS AND DISCLOSURE

6.1 General

Public consultation is useful for gathering environmental data, understanding likely impacts, determining community and individual preferences, selecting project alternatives and designing viable and sustainable mitigation and compensation plans.

Public consultation in the ESIA process is undertaken during the project design, implementation and initial operation. The aim is to disseminate information to interested and affected parties (stakeholders), solicit their views and consult on sensitive issues.

Public consultation process for the Northern Collector Tunnel Phase 1 project took place at the scoping stage and the ESIA stage. The main objective for the consultation process was to involve the community at the very early stage of design so as to identify likely negative impacts and find ways to minimise negative impacts and enhance positive impacts of the project within the final design.

Public participation in all stages of the project is likely to contribute to maximisation of expected benefits and minimisation of mitigation costs of expected negative socio-economic impacts on the immediate environment.

6.1.1 Objectives of the Public consultation

An important element in the process of impact assessment is consulting with stakeholders to gather the information needed to complete the assessment.

The overall goal of the consultation process is to disseminate project information and to incorporate the views of the Project Affected Persons (PAPs) in the design of the mitigation measures and a management plan as well as in the preparation of the Resettlement Action Plan for the Northern Collector Tunnel wayleave.

The specific aims of the consultation process during the ESIA study stage were:

- To inform the local people, leaders and other stakeholders about the proposed Northern Collector Tunnel- Phase 1 project and its objectives;
- Obtain the main concerns and perceptions of the population and their representatives regarding the project;
- Obtain opinions and suggestions directly from the affected communities on their preferred mitigation measures;
- To find out if there are issues or places of cultural/or religious importance to the local communities that could be negatively impacted upon by the project and its infrastructure;
- To Improve project design and, thereby, minimize conflicts and delays in implementation;
- To facilitate the development of appropriate and acceptable entitlement options;
- To increase long term project sustainability and ownership; and
- To reduce problems of institutional coordination, especially at the different levels of Government.

The specific aims of the consultation process during the RAP study were to:

- Make the resettlement process participatory and transparent;
- Facilitate the development of appropriate and acceptable entitlement options;
- Increase the effectiveness and sustainability of income restoration strategies, and improve coping mechanisms;
- Provide a platform for future consultation by:

- Reducing conflict through early identification of contentious issues;
- Improving transparency and accountability of decision making;
- Facilitating participation to increase public confidence in the RAP process;
- Identifying local leaders with whom further dialogue can be continued in subsequent stages of the project.
- Reduce problems of institutional coordination creating awareness and incorporating views of all institutional stakeholders; and
- Increase long term Project sustainability and ownership.

6.2 Previous Consultations

6.2.1 Stakeholder Consultations at Scoping Stage

The study team held introductory meetings with key stakeholders at the scoping stage between 10- 22nd April, 2014. These meetings served as an introduction of the Northern Collector Tunnel- Phase 1 project and set the ground for the ESIA studies and RAP studies held from the month of August to early October, 2014.

Consultations with the Sub-County administration in Kangema and Kigumo Sub-Counties were done during the preliminary field visits to notify them of the proposed project as well as to aid in identification of relevant institutional stakeholders to be consulted during the ESIA study.

The key stakeholders that were consulted included:

- Mr. J.G Kamau- Deputy County Commissioner (DCC) - Kangema Sub County;
- Mr. Charles Langat- Assistant County Commissioner (ACC) on behalf of the DCC - Kigumo Sub County;
- Mr. David Gichoni- Sub County Water Officer- Kigumo Sub County;
- Ms. Faith Mbathi- Service Water Officer (WRMA) – Muranga Sub Region;
- Hon. Anderson Muchemi Waweru- Member of the County Assembly- Kangari Ward;
- Hon. Caroline Wairimu Njoroge – Member of the County Assembly- Kigumo Ward;
- Hon. Charles Mwangi Kirigwi – Member of the County Assembly- Kinyona Ward;
- Hon. Peter Irungu Kihungi- Member of the County Assembly – Kanayanyaini Ward;
- Hon. David Muhoro Njeri – Member of the County Assembly – Kariara Ward

The main issues of concern at this stage were identification of crucial issues for further consultations during the full impact assessment study.

6.2.2 Summary of issues raised

Table 6-1 below is a summary of the issues raised by the stakeholders during consultations at the Scoping stage of the studies.

Table 6-1: Summary of issues raised during the Scoping Stage

| Date | Consultation with | Designation | Outcome |
|------------|--------------------|---|---|
| 17/04/2014 | Mr. J. G. Kamau | Deputy County Commissioner (DCC) – Kangema Sub-County | -Supportive of the project; -Said that compensation of affected land owners should be considered because houses should not be built on top of the collector tunnel; -Conservation of the area should be considered. |
| | Mr. Charles Langat | Assistant County Commissioner | -Compensation is always an issue in the area; -The project will result in some social |

| Date | Consultation with | Designation | Outcome |
|------------|------------------------------|---|---|
| | | (ACC) – Kigumo Sub-County | <p>impacts such as the influx of people into the area;</p> <p>-They have another water project within the sub-county known as Muranga bulk water project which is meant to distribute water to the entire region.</p> |
| | Mr. David Gichoni | Sub-County Water Officer - Kigumo | <p>The Sub-County Water Officer raised the following concerns:</p> <p>-Interference with the existing infrastructure e.g. water pipes , electricity etc;</p> <p>-Problems with relocation of homes and graves. Negotiating land prices for the wayleaves normally takes a long time and its expensive;</p> <p>-Abstraction point for the Northern Collector Tunnel should be below the existing intake for Muranga Bulk Water Project;</p> <p>-Irati River is of interest to them since the intake of the proposed project will be upstream of their intake at Kewambeu for Muranga Urban Water Supply Project.</p> |
| 22/04/2014 | Ms. Faith Mbathi | Service Water Officer – Water Resources Management Authority (WRMA)- Muranga Office | <p>-Water as a resource is not adequate and would have preferred construction of another dam instead of a collector tunnel;</p> <p>-Water conservation is very important and this should be considered before tapping any water;</p> <p>-Currently, they are planting trees at the catchment through the Water Resource Users Associations (WRUAs). They undertake capacity building in order for the WRUAs to take care of the catchment. They have sub-catchment development plans;</p> <p>-Irati River is already tapped. The hydrologist should therefore undertake studies on the rivers to be tapped by the proposed project taking into account the abstractions within the sub-catchment in order to ascertain if the water will be adequate;</p> <p>-The hydrologist should be registered with WRMA;</p> <p>-Permit will be issued from Muranga Office;</p> <p>-The proposed project should take care of the soils so that the soils are not washed into the rivers.</p> |
| | Hon. Anderson Muchemi Waweru | Member of County Assembly (MCA) – Kangari Ward | <p>-Public consultations is key;</p> <p>-Need to know the amount of water to be drawn from each of the three rivers. They consider water as a mineral resource in the County as its becoming scarce;</p> |
| | Hon. Caroline | MCA – Kigumo | <p>-Project may lead to reduced water levels</p> |

| Date | Consultation with | Designation | Outcome |
|-----------------------------|------------------------|-------------|---|
| | Wairimu Njoroge | Ward | <p>in the rivers. Studies should therefore be done during the dry season;</p> <ul style="list-style-type: none"> -Long-term benefits of the project to the communities should be considered since Ndakaini dam has no returns to the surrounding communities; -Chathanda Water Project is downstream of our proposed intake location at Irati and this might be affected by the proposed project; -The communities upstream of these rivers and who are the owners of this water resource do not have tapped water; -Water demands for mini-hydros for the tea and coffee factories should be taken care of; -Ndakaini dam has changed the micro-climate in the area leading to cold related diseases e.g. Pneumonia and Arthritis. The project should therefore consider Corporate Social Responsibility (CSR) activities such as provision of fully equipped medical facilities; -Roads within the proposed project area should be improved to bitumen standard; -Consider CSR activities such as building of resource centres and classrooms; -Labour should not be imported during construction phase except for skilled labour; -Undertake conservation activities i.e. afforestation; -Limit destructive activities in the Aberdare forest by providing locals with alternative sources of livelihoods which will reduce encroachment of the forest; -Some water should be left for irrigation activities. |
| Hon. Charles Mwangi Kirigwi | MCA – Kinyona Ward | | |
| Hon. Peter Irungu Kihungi | MCA – Kanyenyeini Ward | | |
| Hon. David Muhoro Njeri | MCA – Kariara Ward | | |

6.3 Stakeholder Consultations during ESIA and RAP

6.3.1 Consultations during the ESIA and RAP Study

Second round of stakeholder consultations were held at the full ESIA study and RAP stage with already identified stakeholders at the scoping and ESIA stage. This included the County, Sub County Administrative heads and heads of department in the affected line ministries within Kangema and Kigumo Sub Counties as well as those in Muranga County headquarters. Objectives of these meetings were to:

- Introduce the Project to the local area administration;
- Obtain more information about the project area;
- Introduce the consultancy team and the scope of work;
- Obtain views of the local area administration on the project;
- Collect baseline information from the 2 target Sub Counties i.e. Kangema and Kigumo.

Prior to the study team mobilising to site, a stakeholders schedule was prepared so as to guide the team in the consultation process during the full study stage. Table 6-2 below gives a summary of the stakeholder schedule used.

Table 6-2: Schedule of stakeholders consulted during the ESIA and RAP stage

| PROJECT STAKEHOLDERS | | |
|------------------------|---|--|
| Primary Stakeholders | | |
| No. | Name | Category |
| 1. | Athi Water Services Board (AWSB) | Project proponent |
| 2. | Population in Ichichii, Kiruri, Makomboki, Kangari, Gacharage, Kinyona and Kamukabi | Project Affected Persons |
| 3. | Governor Muranga County | County Government |
| 4. | Governor Nairobi County | |
| 5. | Members of County Assembly - Muranga | |
| 6. | County Commissioner Muranga | Ministry of Interior and Coordination of National Government |
| 7. | Deputy County Commissioners – Kigumo and Kangema Sub-counties | |
| 8. | Members of Parliament – Kigumo, Kangema and Gatanga | National Legislature |
| 9. | Water Resources Management Authority (WRMA) | Water Regulatory Body |
| 10. | Nairobi City Water and Sewerage Company Limited | Project beneficiaries |
| 11. | Ruiru-Juja Water and Sewerage Co Ltd. | |
| 12. | Kiambu Water and Sewerage Co Ltd. (KIWASCO) | |
| 13. | Karuri Water and Sanitation Co Ltd. (KAWASCO) | |
| 14. | Mavoko Water & Sewerage Company (MAVWASCO) | |
| 15. | Oloolaiser Water and Sewerage Company | |
| 16. | Kikuyu Water Co Ltd. | |
| 17. | Maragua Water Users Association | Water Users of Maragua, Irati and Gikigie Rivers |
| Secondary Stakeholders | | |
| 1. | Tana Water Services Board (TWSB) | Water Board |
| 2. | Murang'a Water and Sanitation Company; | Water Service Providers |
| 3. | Kahuti Water & Sanitation Company; | |
| 4. | Murang'a South Water & Sanitation Company | |
| 5. | Gatamathi Water And Sanitation Company; | |
| 6. | Gatanga Community Water Scheme | |
| 7. | KenGen | Bulk Water Consumers/ Users |
| 8. | Kenya Tea Development Authority (KTDA) | National Government Line |
| 9. | Sub-County Water Officer | |

| PROJECT STAKEHOLDERS | | |
|----------------------|--|-------------------------------------|
| 10. | Physical Planning Office | Ministries |
| 11. | Public Health Officers | |
| 12. | NEMA County Officer in Muranga | National Government Line Ministries |
| 13. | Department of gender and social development | |
| 14. | Fisheries Officers | |
| 15. | Agriculture Officers – District Agriculture Officer and District Livestock Development Officer | |
| 16. | Sub-county Lands Officer; | |
| 17. | Sub-County Development Officer (DDO); | |

Further from the summary of stakeholders listed before mobilising to site additional stakeholders were identified on site and consulted so as to have wide consultations in the project area and beyond. Contacts of stakeholders consulted during this phase are as presented in Appendix VI.

6.3.2 Stakeholder identification

To enhance maximum participation and achieve a better output, the right stakeholders were taken on board. This was done through stakeholder identification and involvement based on their needs, interests, relative power and potential impact on project outcome.

In this regard, two broad categories of stakeholders were identified. These include:

- *Primary stakeholders* – those who are the beneficiaries of a development intervention or those directly affected (positively or negatively), by the project, commonly referred to as Project Affected Persons (PAPs);
- *Secondary stakeholder*- those who influence development or are indirectly affected by the project especially those stakeholders involved in resettlement planning and implementation. These include the implementing agency, relevant government departments, and local administration among others.

6.3.3 Approach and implementation of public consultations

From the environmental baseline described in Chapter 3, it was evident that the project area in both Kangema and Kigumo Sub Counties is a tea planting area, thus the settlements are scattered. In order to reach the PAPs within the affected areas/ within project foot print during the public consultation, the following was done:

- Introductory meetings were held with the Deputy County Commissioners (DCC) and Assistant County Commissioner's of each Sub County to introduce the project and proposed activities. This was aided by the presentation of a letter from AWSB introducing the study team on site (see attached in Appendix VI);
- Meetings were set-up with the Assistant County Commissioner's and the Chiefs of the different Sub Counties to explain the project and activities being carried out at this stage. Subsequently, the Chiefs were taken through the areas where the proposed Northern Collector Tunnel- Phase 1 is to pass for purposes of identification of PAPs to be invited to the public meetings; and
- Public meetings were set and held in areas accessible to all PAPs.

Table 6-3 shows the photo plates showing some of the meetings held at the different levels of consultations during the ESIA and RAP studies in Kangema and Kigumo Sub Counties.

Table 6-3: Photo plates of various Consultative meetings held during the study

| Introductory Meetings | |
|---|---|
|  |  |
| <p><i>Photo 1: Introductory meeting with the Deputy County Commissioner- Kangema Sub County - Mr. J.G. Kamau on 4th August, 2014</i></p> | <p><i>Photo 2: Introductory meeting with the Deputy County Commissioner- Kigumo Sub County and the ACC with Chiefs from the affected areas on 4th August, 2014</i></p> |
| Stakeholder Consultations/ Interviews | |
|  |  |
| <p><i>Photo 3: Stakeholder meeting with Department heads of line ministries in Kangema Sub County (Chairing the meeting is Mrs. M. Tilas, ACC Kangema on 5th August, 2014</i></p> | <p><i>Photo 4: Stakeholder meeting at the KenGen team- Wanjii HEP Station Offices (Bulk User of Maragua River down stream) on 28th August, 2014</i></p> |
| Public Meetings | |
|  |  |
| <p><i>Photo 5: Public meeting at Ichichii Chief's Camp. Addressing the community is Jacob-Sociologist, ESIA& RAP study team on 11th August, 2014</i></p> | <p><i>Photo 6: Public meeting at Mairi Shopping Centre, Kangari Location. Addressing the meeting is Daniel Mbugua, Community Officer from AWSB who attended the public meetings during the ESIA& RAP studies on 13th August, 2014</i></p> |

Focus Group Discussions



Photo 7: Focus Group Discussions meeting with Elders from Kangema Sub County at Ichichii Chief's Camp. Facilitating the discussions is Jacob, ESIA & RAP Study team on 25th August, 2014



Photo 8: Focus Group Discussions meeting with youths from Kigumo Sub County at the Makomboki Chief's Camp. Facilitating the discussion is Michael- Environmentalist, ESIA & RAP study team on 26th August, 2014

6.4 Summary of Stakeholders Comments

A summary of the issues raised by the consulted stakeholders in interviews, stakeholder forums and meetings are presented in Table 6-4.

Table 6-4: Summary of the issues rising from the stakeholders consultations

| SN | Category of stakeholders | Suggestions and Positive & Negative Impacts | Issues and Concern | Response from the consultant team |
|----|---------------------------|--|--|--|
| 1. | Department of Fisheries | Impact on fish species and fish farmers | <ul style="list-style-type: none"> • Reduced river flow/ volumes down stream; • Intake structure preventing migratory fish upstream. | <ul style="list-style-type: none"> • The proposed project is designed to use flood water flows only; • The weir in the intake points will have provision for fish pass to ensure continuous migration. |
| 2. | Department of Agriculture | <ul style="list-style-type: none"> • Reduced crop production; • Safety risk of farmers at the intake and outfall areas; • Air Pollution | <ul style="list-style-type: none"> • Uprooting crops during the construction and dumping of spoils on farm lands; • Blockage and pollution of streams during construction; • Displacement of farmers paving way for the wayleave for the Tunnel; • Easy alternative for income, turning from Agriculture; • The risk of flooding farms and safety of the farmers during operation; • Disposal of spoil/ excavated materials; • Soil conservation measures in the area; • Air/ dust pollution during construction | <ul style="list-style-type: none"> • The contractor on site will have strict mitigation measures to follow, such as reinstating and compensation of crops affected by construction activity; • Any construction activity will be done in a controlled environment, consideration given to rivers and streams; • Safe disposal and management of spoils will be recommended as per NEMA guidelines on waste management that will be noted in the ESMP; • Public awareness will be recommended for the community to ensure education and agricultural activities are not affected adversely in the project area. (Refer to comment by education officer); • The ESMP will recommend fencing off the intake and outfall structures to avoid danger of drowning and restrict access to the hazardous sites; • A buffer zone will be demarcated to show the extent of flood waters at the intakes and out fall area; • Recommendations to have the roads wetted to reduce dust ad air pollution will be given in the ESMP; • Contractor will be expected to regularly maintain his vehicles and equipments to prevent air pollution as recommended in the |

| SN | Category of stakeholders | Suggestions and Positive & Negative Impacts | Issues and Concern | Response from the consultant team |
|----|----------------------------------|---|--|---|
| | | | | ESMP. |
| 3. | Department of Health | <ul style="list-style-type: none"> Increased eye infection during construction; Increased STDs in the area; Rise in cases of accidents and incidents; Pollution of water through disposal of waste and oil from construction equipment; Increase in noise pollution at the construction sites; Increased cases of unwanted pregnancies | <ul style="list-style-type: none"> Workers and public safety; Water and soil pollution during construction; Community health and increase in disease prevalence and unwanted teenage pregnancies. | <p>The ESMP will recommend the following as mitigation measures to the foreseen impacts including:</p> <ul style="list-style-type: none"> Regular wetting of the grounds at the work place; Contractor to ensure provision of condom dispensers at the camps and work sites; Provision of PPE to the workers at all working hours; Adequate installation of safety signage along the road and work sites (site specific); Oiling and greasing of equipment should be done far from water bodies in the area; ensure regular maintenance of vehicles and equipment; Noise levels should be within the legal limits as per OSHA 2007, and NEMA guidelines; Public awareness will be recommended for the community to ensure control and curbing teenage promiscuity. |
| 4. | Department of Social Development | <ul style="list-style-type: none"> Employment opportunities and job creation; Increased sale in crop production especially food products from farmers; Increased activities related to trading due to availability of markets; Increased school drop outs; Teenage pregnancies; HIV/ AIDS increase; Damage to roads during construction; Relocation of population | <ul style="list-style-type: none"> Impacts on education and the school system; Community/ public health; Community development- infrastructure; Conservation and tree planting in the area; Loss of land and assets | <p>Recommendations taken into consideration from consultations are as follows:</p> <ul style="list-style-type: none"> Public awareness will be done on risks of STIS and HIV/AIDS; Information, Education and Communication campaigns will be conducted by the contractors for contractors' personnel and local communities; The contractor should be discouraged and warned of any cases of child labour; There will be training and sanctions for contractors to prevent illicit behaviour by workers; All damaged roads will be reinstated during and after construction; |

| SN | Category of stakeholders | Suggestions and Positive & Negative Impacts | Issues and Concern | Response from the consultant team |
|----|-----------------------------------|--|--|---|
| | | and loss of land | | <ul style="list-style-type: none"> Alternative traffic arrangements will be set up where necessary to avoid accidents and reduce disruption of access for communities. Proposed tree planting by AWSB should be done as a measure to sustain the environment; <p>The proposed NCT wayleave will be a controlled area that will have an aspect of co-ownership with the farmer, thus no relocation, houses and structures on ground within the wayleave will be compensated.</p> |
| 5. | Deputy County Commissioner | <ul style="list-style-type: none"> Increased reliable water supply in the south of Muranga; Damage to roads in the area. | <ul style="list-style-type: none"> Water supply to Muranga County; Road network- the contractor should sign an agreement with the community to ensure that roads will be reinstated. | <ul style="list-style-type: none"> The recommendation given to have the contractor sign an agreement with the community to ensure that roads will be reinstated and or improved will be considered in the ESMP. |
| 6. | Forestry Department | <ul style="list-style-type: none"> Impact of felled exotic species in the project area | <ul style="list-style-type: none"> Reduced forest cover; and Loss of fuel wood used for economic importance of the exotic tree species for fuel wood- Tea factories; Loss of productivity land | <ul style="list-style-type: none"> All trees affected in the project area will be compensated as per the economic value of the tree products; Ensure compensation for land is done correctly and fairly; involve local leaders in the exercise to ensure transparency and reduced conflicts. |
| 7. | Water Department | <ul style="list-style-type: none"> Reduced water flows down stream; Disruption of ground water systems; Vibrations due to underground work activities | <ul style="list-style-type: none"> Reduction of flows below the abstraction points in the three rivers hence affects other major abstractors down stream; Disruption of ground water down stream affecting the lower sections of Muranga County; Sound vibrations will affect human and livestock daily operations; | <ul style="list-style-type: none"> The proposed NCT will abstract the flood flow only and not the normal flows; The proposed kick-back projects aim to mitigate the impact to the lower sections of the County; The contractor implementing the proposed project will have technical engineers and equipment monitoring noise and vibration levels during construction. |
| 8. | Water Resources Management (WRMA) | <ul style="list-style-type: none"> Reduced water levels down stream that may lead to water conflicts between down stream | <ul style="list-style-type: none"> The current water flows during the dry season is below the proposed abstraction from the three rivers; The source of livelihood will be affected due to | <ul style="list-style-type: none"> The proposed NCT will abstract the flood flow only and not the normal flows; <p>Recommendation taken into consideration are:</p> |

| SN | Category of stakeholders | Suggestions and Positive & Negative Impacts | Issues and Concern | Response from the consultant team |
|-----|------------------------------|--|--|--|
| | | <ul style="list-style-type: none"> users; Interference with the ecological system; Catchment degradation during construction-siltation down stream. | <ul style="list-style-type: none"> reduced water levels down stream; Introduce alternative water sourcing by the community- such as rainwater harvesting; Siltation and turbidity increase due to construction activities upstream; From the spot gauging equipment the three rivers are below the proposed water levels to abstract at the moment (dry season); AWSB could assist in conducting a Water Abstraction Survey to identify all abstractors along the Maragua River system. | <ul style="list-style-type: none"> Collaborate with the stakeholders in Water resource management such as WRMA, NEMA, WSPs, County Government, Min of Agriculture, Fisheries, Livestock and the community; Control surface run off during construction; GIBB study team has had various consultative forums with the departments to discuss the likely impacts and mitigation measures; Ensure an ESIA is done pointing out all the ecological and environmental/ social impacts with mitigation measures given; Put in infrastructure in place to reserve the flood water to use during dry spell (July- Sep and Dec- March); Construction activities at the river intakes will have silt traps and sedimentation barriers- infrastructure that will arrest any silt down stream. |
| 9. | Department of Land | <ul style="list-style-type: none"> Increased land conflicts due to increased demand of land | <ul style="list-style-type: none"> Land disputes | <p>Recommendation on the land issues to be considered are:</p> <ul style="list-style-type: none"> Boundary disputes are usually handled at the Sub County Land Registrar office; Other land disputes will usually be recommended to Court; Ensure that the land rates used in valuation are up to date with the values on ground to ensure fairness in compensation. |
| 10. | Physical Planning Department | <ul style="list-style-type: none"> Future land/ wayleave conflicts in land use | <ul style="list-style-type: none"> Easement of the controlled land use area | <p>Recommendations considered from the consultations are:</p> <ul style="list-style-type: none"> Ensure that the easement compensation covers all the affected land parcels to ensure all people along the tunnel are aware of the limitations of controlled land use; Ensure the proponent places permanent |

| SN | Category of stakeholders | Suggestions and Positive & Negative Impacts | Issues and Concern | Response from the consultant team |
|-----|---|---|--|--|
| | | | | markers (such as the ones that mark road reserves) to avoid future land use that is not acceptable within the wayleave. |
| 11. | National Environmental Management Authority (NEMA)-Murang'a | <ul style="list-style-type: none"> Proposed kick-back water supply projects to Muranga is a very positive impact; Easement of land acquired for the proposed NCT wayleave; Possible impact on landslides and earth movements; Impact on water levels; Public / community involvement; Ecological impacts of the rivers; Waste management | <ul style="list-style-type: none"> Kenol town is rapidly growing town/ centre that is being planned as a commercial centre for Muranga; It's important for the proponent to survey the land and have an easement and gazette the land as a Special Planning Zone to control future land use; The ESIA study and technical Geological study reports should give mitigation measures to avoid landslides. The landslide prone areas in Muranga are: Karikoini Gatuya Location in Kahuru area (past case in 2003, landslide affecting- 35 households); Its important to ensure sustainability of the water flows of the three rivers; It's important to involve the County Government in the studies and planning phases as well as the implementation phase of the project; Its important to consider the ecological impact of the abstraction and inter-basin transfer of water; The waste produced from the spoils and camp sites should be managed as per the NEMA guidelines. Materials from underground can be used to rehabilitate the roads within the area. | <ul style="list-style-type: none"> The proponent will after the compensation, conduct a land use change to the Special Planning Zone as required by law; The geological study report will give the under earth rock structure to flag any dangers of landslides caused by vibrations; The implementing engineers will have technical persons to monitor any earth movements in addition to the equipments that will be installed in the area to detect and monitor earth movements; The proposed project will abstract the flood water flows only. The intake infrastructure is designed in a way that ensures the gates close upon lower levels than flood flows; Various consultative meetings have been held with representatives of the County Assembly and Government; Hydrological studies have been carried out in the area to determine the demand flows, proposed abstraction and resultant impact downstream; Waste management rules and NEMA guidelines will be recommended to the proponent and contractor in the ESMP. |
| 12. | Makomboki Tea Factory (KTDA) | <ul style="list-style-type: none"> Employment of the locals during construction; Additional water to Ndakaini Dam thus boosting water supply to Nairobi City; Destruction of environment especially | <ul style="list-style-type: none"> Employment opportunities and economic benefits; Additional water supply to Nairobi City; Environmental impacts of the proposed project during construction such as vegetation reduction and soil erosion. | <ul style="list-style-type: none"> The proposed project is to be implemented as a measure to the Nairobi Urban Master Plan; This ESIA and RAP studies are being conducted to ensure proper mitigation measures are given to avoid adverse environmental impacts. |

| SN | Category of stakeholders | Suggestions and Positive & Negative Impacts | Issues and Concern | Response from the consultant team |
|-----|--|--|--|---|
| | | trees in the area | | |
| 13. | Muranga Water and Sanitation Company (MUWASCo) | <ul style="list-style-type: none"> • Employment of the youth; • Improvements of roads in the area; | <ul style="list-style-type: none"> • The youth of the area will have employment opportunities that will come with the proposed project; • Infrastructure improvement | <ul style="list-style-type: none"> • Comments were noted |
| 14. | Gatamathi/ Kahuti Water and Sanitation Company | <ul style="list-style-type: none"> • Employment of the youth | <ul style="list-style-type: none"> • The youth of the area will have employment opportunities that will come with the proposed project | <ul style="list-style-type: none"> • Comments noted |
| 15. | Maragua Water Users Association | <ul style="list-style-type: none"> • Employment opportunities; • The flow of water to users downstream will reduce. | <ul style="list-style-type: none"> • Increase of employment of the community members; • Business will increase in the centres around the areas in Kangema and Kigumo Sub Counties; • Reduced water levels downstream. Ensure the water levels are maintained so as not to affect the downstream users; • The current flows for the three rivers is okay at the moment. | <ul style="list-style-type: none"> • The proposed project will abstract the flood water flows only. The intake infrastructure is designed in a way that ensures the gates close upon lower levels than flood flows; |
| 16. | KenGen | <ul style="list-style-type: none"> • Effect of abstraction upstream on Wanjii and Mesco HEP stations; • Reduced water levels and impact on the cascades downstream in Tana River; • Impact of fish species upstream | <ul style="list-style-type: none"> • Impact of over abstraction as observed in Thika (Ndula Hydro- Power Station), where the station had to be closed down due to over abstraction; • Concern is the sustainability aspect of the proposed development in the entire region as more developments are planned along the Maragua river system; • Impact of migratory aquatic species upstream with the intake infrastructure in place; • KenGen has plans to raise the Masinga Dam by 1.5m, thus adding storage, the preferred option of the Maragua project would be the dam to ensure storage of flood water during high rainfall season; • | <ul style="list-style-type: none"> • The proposed NCT will be abstracting flood flow water in the three rivers, therefore the normal base flow will continue down stream; • The intake infrastructure is designed in a way that ensures the gates close upon lower levels than flood flows ; • Its important to involve all stakeholders in the planning of any water use development in the region, that will inform such stakeholders as KenGen on the sustainability of their operations; • The proposed designs of the intake structures has a provision of 'fish ladders' that allow fish to migrate upwards and down stream |
| 17. | Tana Water Services Board | <ul style="list-style-type: none"> • Water conflicts due to decreased water levels; | <ul style="list-style-type: none"> • Issues of water rights and usage between Nairobi and Muranga. It is important to limit conflicts | <ul style="list-style-type: none"> • The proposed NCT will be abstracting flood flow water in the three rivers, therefore the |

| SN | Category of stakeholders | Suggestions and Positive & Negative Impacts | Issues and Concern | Response from the consultant team |
|----|--------------------------|---|--|---|
| | | <ul style="list-style-type: none"> • Catchment protection and conservation; • Impact of blasting and excavation underground; • Dumping of spoils on farms; • Social impacts during construction | <p>between the two Counties by ensuring that water is abstracted during the wet season (flood flow) and ensure that the abstraction is automated;</p> <ul style="list-style-type: none"> • Propose a joint operation of the NCT with local water service providers to supply water and ensure water supply to the upper catchment community; • The possibility of increased sexual activities that are illegal in the area | <p>normal base flow will continue down stream;</p> <ul style="list-style-type: none"> • The intake infrastructure is designed in a way that ensures the gates close upon lower levels than flood flows; • Catchment management by AWSB will be highly recommended during the construction and operation phases of the proposed project; • All construction activities will be under controlled environment to avoid impacts of blasting and irregular excavation vibrations; • Spoil sites have been identified and will be compensated accordingly for use during construction; • Public sensitization will be recommended to be done in the area by the proponent and the contractor both at the Contractors camp and local shopping centres; • |

6.5 Consultations with Project Beneficiaries

The ESIA study team held consultative meetings with the project beneficiaries of the Northern Collector Tunnel- Phase 1 during the full study stage.

The aims and objectives of consultation at this level were to inform, collect data on capacity analysis and comments on the project proposed by AWSB. These Water Service Providers include the following:

- Mavoko Water and Sewerage Company;
- Kiambu Water and Sewerage Company;
- Ruiru- Juja Water and Sewerage Company;
- Karuri Water and Sanitation Company;
- Kikuyu Water Company;
- Oloolaiser Water and Sewerage Company; and
- Nairobi Water and Sewerage Company

The out put of the consultations are given in Table 6-5 below:

Table 6-5: Summary of capacities of the different Water Service Providers (Project Beneficiaries)

| No. | Bulk Water Service Provider | Area of Coverage | Main Sources of Water | Capacity (Supply and Demand Volumes) | Remark/ Comments |
|-----|---|---|--|--|--|
| 1. | Nairobi Water and Sewerage Company (NCW&SC) | Nairobi City County NCW&SC is also responsible for the operation of Thika dam and the existing Ngethu-Gigiri-Kabete lines and associated water works | Thika dam Sasumua dam and Kikuyu springs | The current supply capacity is about 540,000m ³ /d against a demand of about 650,000m ³ /d. the demand is projected to increase to 790,000m ³ /d by the year 2019 (excluding demand by Mavoko W&S company). | <ul style="list-style-type: none"> • Areas that are served from Kabete reservoir and which are likely to benefit from the increased supply include Kabete, Westlands, State House road, Ngong road, Karen Dagoretti, Eastleigh, Ngara and Parklands. Supply to these areas is currently rationed to a serious extent. • The project is in line with the country's vision 2030 and will partly contribute to poverty eradication and improved sanitation standards from enhanced water supplies • Without commensurate development of trunk sewer infrastructure in the city, incidences of sewer bursts and overflows will increase affecting the environment negatively. • Project may lure students out of school thereby affecting local area education • Experience with Thika Dam shows the need to have some real benefits for the local community in the immediate vicinity of the project area even after payments for compensation. This was |

| No. | Bulk Water Service Provider | Area of Coverage | Main Sources of Water | Capacity (Supply and Demand Volumes) | Remark/ Comments |
|-----|--|---|---|--|---|
| | | | | | lacking in Thika dam and up to date, the immediate community feel cheated. |
| 2. | Mavoko Water and Sewerage Company (MAVWASCo) | <p>This WSP supplies a total area of 697 square kilometres, including:</p> <ul style="list-style-type: none"> • Utawala area; • Syokimau; • Githunguri- Utawala; • Joska area; • Mlologno; • Lukenya; • Athi River Town; • Nzoiani; • Kyumbi; • Konza and Kapiti area; • Kitengela | <p>The main sources of water are:</p> <ul style="list-style-type: none"> • Nairobi Bulk Water supply (60%); • Portland dam (35%); • Boreholes (5%). | <p>The current capacities and supply volumes are:</p> <ul style="list-style-type: none"> • Supply: -6000m³ per day; • Demand: - 25000m³ per day; • Projected demand in 5 years: - 70000m³ per day due to upcoming estates, learning institutions and industries. | <ul style="list-style-type: none"> • The proposed project will therefore be of great value to the growing demand in the area. With the increase in water supply, there is need to develop and upgrade the sewer system of towns surrounding the City of Nairobi. |
| 3. | Kiambu Water and Sewerage Company (KIWASCo) | <p>The Areas covered by the WSP in Kiambu are:</p> <ul style="list-style-type: none"> • Kamiti area; • Ting'ang'a areas; • Kiambu Town; • Kiambu Institute of Science and Technology (KIST); • Kanunga; • Thindigwa; and • Kiamundi | <p>The main sources of water are Nairobi bulk water supply and 12 boreholes in the following areas:</p> <p>Four (4) yield being 20 - 25m³/ hour covering:</p> <ul style="list-style-type: none"> • Kiambu Town; • Thathini Estate; • Kangoya Estate. <p>Four (4) yield 5- 10m³/ hour, covering:</p> <ul style="list-style-type: none"> • Satelite area; • Kangoya (upper) Primary; | <p>The total bulk supply of the Nairobi Water is 3000m³ per day.</p> <p>The total yield of the boreholes is 1500m³ per day.</p> <p>Total supply is 4500m³ per day.</p> <p>The current demand is 13000 m³ per day.</p> | <ul style="list-style-type: none"> • The mitigation measure in place to share the limited water supply is through rationing (one and three week schedules depending on the area); • Biggest challenge in operation is the cost of energy in the pumping of water. |

| No. | Bulk Water Service Provider | Area of Coverage | Main Sources of Water | Capacity (Supply and Demand Volumes) | Remark/ Comments |
|-----|---|---|---|--------------------------------------|---|
| | | | <ul style="list-style-type: none"> The Government Offices. <p>Four (4) yield being 1- 3m³/ hour covering:</p> <ul style="list-style-type: none"> Gichocho area/ village; Kihingo; Ndumberi; Karunga area (currently dried up). | | |
| 4. | Ruiru- Juja Water and Sewerage Company (RUJWASCo) | <p>The area of coverage is currently at 60% of the potential area.</p> <p>The areas covered in Ruiru region are:</p> <ul style="list-style-type: none"> Ruiru East zone; Murera A & B; Thome area; Kimbo area; Mugutha area; Ruiru town; Gitanbaya area; Prison area; Membley estate <p>The areas covered in Juja Region are:</p> <ul style="list-style-type: none"> Kalimoni area; Wood estate; Joyland estate; Gatagama (JKUAT entrance); Ithuri; | <p>The main sources of water are:</p> <ul style="list-style-type: none"> Ruiru River; and Ndarungo River in Juja <p>The two rivers have a new intake with a capacity of 13000m³ in Ruiru River and 4000m³ in Ndarungo River.</p> <p>Other sources are the Mirimani Boreholes.</p> | | <ul style="list-style-type: none"> The limitation of the new water supply from the two rivers is the existing old networks that cannot carry the excess water; Currently using 6 inch pipelines which are limited to push water further; There is a rapid growing demand due to the settlements along the Thika Super High Way |

| No. | Bulk Water Service Provider | Area of Coverage | Main Sources of Water | Capacity (Supply and Demand Volumes) | Remark/ Comments |
|-----|---|--|--|---|---|
| | | <ul style="list-style-type: none"> • High point; • Gachororo; • Kenyatta Road A &B; • Kanini estate; • Greenfield estate; and • Milimani borehole (beyond JKUAT). | | | |
| 5. | Karuri Water and Sewerage Company (KAWASCo) | <p>The WSP covers areas in the formerly known areas in Karuri Town Council, including:</p> <ul style="list-style-type: none"> • Karuri Ward; • Muchata Ward; • Ndenderu Ward; • Kihara Ward; • Cianda Ward. | <p>The main sources of water are boreholes and bulk water supply off-takes from the Sasumua lines to Nairobi.</p> <p>The boreholes are located in different areas in Kiambaa Sub-County, Kiambu County, supplying areas including:</p> <ul style="list-style-type: none"> • 1no in Wagutho Location; • 1no in Kimuga Location; • 2no in Karura Location; • 2no in Karuri Location; • 1no in Ruaka Sub Location; • 1no in Gacharage Sub Location; • 1no in Ndenderu Sub Location. <p>Other main sources are off-takes from the Sasumua line including the following connections:</p> <ul style="list-style-type: none"> • 1no Ruaka connection (bulk); • 1no Muchatha connection (bulk); • 1no Wagutho off- take (bulk); • 1no Gachie off-take (bulk); and • 1no Njoro off-take (bulk). | <p>The volumes produced in average from the two sources are:</p> <ul style="list-style-type: none"> • Boreholes- 35611m³/ month; • Bulk off-takes- 54494m³/ month <p>Total supply is 90105m³ per month or 3000m³ per day.</p> <p>The current demand in the area of coverage is 11000m³ per day.</p> <p>Largest demand areas are: Karuri, Muchatha, Ndenderu and Ruaka areas.</p> | <p>The major challenge in operations is the cost of pumping water from boreholes in to storage tanks.</p> <p>The NCT water supply project is very much welcome and are eager to get additional allocations due to the capacity gap.</p> |
| 6. | Kikuyu Water Company | Areas of coverage | Main sources are 13 boreholes | The current capacities | The proposed NCT will increase |

| No. | Bulk Water Service Provider | Area of Coverage | Main Sources of Water | Capacity (Supply and Demand Volumes) | Remark/ Comments |
|-----|---------------------------------------|---|---|---|---|
| | | includes areas in Kikuyu and Kabete Sub Counties | | of the boreholes are 4500m3 per day The current demand is at 27000m3 per day. | water supply to Nairobi but not to Kikuyu which is in dire need of gravity water. The cost of pumping water to Kikuyu town is a burden to operations. The additional water supply should be followed by improvement of Waste water management system. The contractor should reinstate the environment in Kangema and Kigumo after construction completion. |
| 7. | Oloosaiser Water and Sewerage Company | The areas of coverage is within the greater Kajiado North Sub County, covering areas 716 km2, including areas such as: Ngong and Ol' Rongai areas, including: <ul style="list-style-type: none"> • Kiserian; • Lemelepo; • Ngong; • Nkaimurunya; • Olchooronyore; • Olkari; • Oloolua; and • Ongata Rongai Locaitons. | The main sources of water are Kiserian dam, Mbagathi River intake and several boreholes. The company has three independent schemes, including: <ul style="list-style-type: none"> • Ongata Rongai served by River Mbagathi intake; • Kiserian and parts of Rongai served by 5no boreholes and springs; • Ngong town served by 8no boreholes and 1no spring; • Kiserian served by Kiserian Dam | The current capacities in the area are: Supply service capacity on average is 6500m3 per day; Projected demand is 26418m3 per day | Increased assured supply of quality and quantities to meet the current demands; The supply from the NCT will bridge the water supply/ demand deficit; |

6.6 Focus Group Discussions Meetings

A total of five (5) Focus Group Community meetings were conducted with the Project Affected Persons (PAPs) in Kangema and Kigumo Sub Counties, three in each Sub County. The objectives of these meetings were to:

- Understand how land is managed within the community;
- Understand the roles of the different community levels (Elders, Women and Youth groups); and to understand how
- Culture and natural resources seen as of importance to the community

The venues of the meetings for discussions were in Ichichii Chief's Camp and Makomboki Chief's Camp in Kangema and Kigumo Sub Counties respectively.

The following sections give a summary of the issues raised in the meetings.

6.6.1 Employment Opportunities

Youths from the project area complained of lack of employment. They lamented that the government lacked proper plans to involve the youths. They complained that there were some youth who had university degrees and without jobs in the area. They blamed the lack of jobs to lack of skills being matched to the job market.

The youth wanted to know if employees would be sourced from outside the catchment area whereas there were youth who were capable of doing the work. They suggested that the youth coming from the area be given first priority in all the available opportunities.

Members of the discussion meeting from the FDG- Youth wanted to know the conditions for employment and if the workers would receive an insurance policy.

The study team responded by informing that insurance cover for all workers was provided for under the occupational health and safety act and thus all the workers were entitled to one. The terms and conditions of work however were dependent on the contract that the workers would sign with the contractors.

6.6.2 Alcoholism among the youth

Alcoholism among the youth was also cited as a challenge in the area. The vice has caused destruction of the social structure through disruption of families in the area. Although alcoholism is the major form of drug abuse other forms exist but in isolation. This is for example the abuse of bhang.

6.6.3 Road networks in the project area

Roads in the area are not in the best condition at present, the youth were concerned that further destruction would occur during construction of the tunnel. The youth are said to be the main road users especially because of the '*bodaboda*' transport business and would therefore be most affected in the event the roads were destroyed.

6.6.4 Land Ownership in the area

Elders from the project area informed the FDG discussions that there are two main ways of land ownership. These are:

- Freehold-Mainly inherited from ancestors; and
- Tea plots- Owned by the County Government

Discussions from the Elders brought out issues of ownership, noting that succession was not a major occurrence in the area. Most of the land was still in the name of their forefathers. However land transfers were common especially when land was sold.

The elders noted that it is important for the valuer to categorise the assets on the ground as they may be owned by someone different from the title holder (land owner).

Members from Elders- FDGs wanted the compensation to focus on both the property owner and the affected parcel of land. Some members suggested on listing all the beneficiaries of compensation especially those that were of legal age to avoid family feuds over compensation.

The Study team explained that GIBB Africa would take the records of all the project affected persons, however the issue on compensation would have to be solved by individual families in conjunction with the local administration.

Family issues pertaining to land ownership also plagues the youth. Most of them complained that their parents had not given them a way forward with regards to land succession. They therefore wanted to know how the compensation will be done to avoid feuds.

The study team noted the concerns and informed the youth FDG of the need to have a family consensus during compensation administration to avoid the problems that may arise due to compensation.

During the Women FDGs in the area, the study team probed on the entitlement of women to land succession in the community. It was established from the meeting that culturally women were not entitled to land succession with the exception of women who were not married or in instances where the father wished to share his land to his daughters.

6.6.5 Social impacts of compensation

During the Elders FDGs, the study team probed on the appropriate proposals to compensation to avoid the occurrence of the noted problems during compensation, such as family feuds and conflict. Members agreed that the most appropriate method would be to go through the local administration in case the issue was not solved at family level. The chief was given the responsibility of summoning members with disputes and solving problems arising from compensation.

The organization structure for conflict resolution that was agreed upon by the members is as follows.

- The chief will receive the cheques of all members to be compensated at his office. Family members who have agreed among themselves on how to divide the compensation will be given the cheques by the chief.
- If there is a problem on division of money between family members the chief will withhold the cheque. The chief will act as a mediator to solve the conflict.
- Depending on the agreement and solution reached upon by the conflicting family, the chief will write to the bank to advice on how to divide the money among the beneficiaries.

Concerns were raised over the historical social impacts during the compensation for land during the development of the Ndakaini/ Thika Dam. The youth of the area felt that with the older generation holding on to land documents and not carrying on with succession, the youth will be left without land or control of development on it after compensation of the NCT. This is in connection to the compensation process during the construction of the Dam that led many youths without land, prior to succession.

The study team responded to the concern, noting that the family should discuss any land ownership and compensation issues before administering the compensation. The youths

suggested that it is important to hold civil education events to inform the community of the expectations during the compensation process and after, i.e. from one village to another.

The elders' discussions noted that it is important for the proponent to disclose the compensation/ valuation roll to the property owners before any development on the wayleave. It is best to communicate this through the local administration (Chiefs and Ass. Chiefs before going to the public, adding that the administration are trusted and well representative of the community in all affected locations.

From elder's discussions it was noted that conflicts may occur during the period of compensation. Suggestions were given in that grievance mechanism should be through the local administration, PAPs representatives from all locations affected and professionals, both local and outside the area.

In general, the participants were informed that the study team was also undertaking a specific study on RAP in line with WB guidelines. The RAP includes census of PAPs, entitlement matrix, summary of consultations, identification of grievance resolution mechanism and disclosures of RAP findings and implementation plan.

6.6.6 Youth Groups in the project area

In Ichichii and Makomboki Locations, the youth members of the community informed the FDG meeting of several youth groups that are in existence in the area. These include:

| Youth Group | Function |
|--|--|
| 1. Abadere youth group | <ul style="list-style-type: none"> Cares for the disabled and does livestock keeping. |
| 2. Makomboki United Football Youth Group | <ul style="list-style-type: none"> Raises conservation awareness through sports |
| 3. Ichichi Youth bunge | <ul style="list-style-type: none"> Transport |
| 4. Digital youth group | <ul style="list-style-type: none"> Livestock keeping |
| 5. Rumathi Self Help Group in Gatura Village, Makomboki Location | <ul style="list-style-type: none"> Livestock keeping for milk production |
| 6. Duika focus for youth development | <ul style="list-style-type: none"> Self-help group |
| 7. Ichichi FC | <ul style="list-style-type: none"> Raises awareness through sports |
| 8. Umoja self-help group | <ul style="list-style-type: none"> Rabbit keeping |
| 9. Joy farmers youth group | <ul style="list-style-type: none"> Planting fruit and tree seedlings, raising awareness on environmental issues |
| 10. Mercy corp | <ul style="list-style-type: none"> Financial support through loans |
| 11. Gabu foundation | <ul style="list-style-type: none"> Supports community projects |
| 12. Ahadi Kenya | <ul style="list-style-type: none"> Anti-jiggers campaign |

The youth of Ichichii gave proposals for support to boost their functions and develop their mandate in the community. The study team informed the members that youth groups are important as they provide an easy avenue for contact and involvement. He therefore encouraged the youth to join youth groups. The proponent will be given the community needs and suggestions given so as to have means of interaction with the community.

6.6.7 Intrusion of new people in the area

Some members of the various FDGs felt that insecurity would deteriorate as a result of the development and construction of the Northern Collector Tunnel. The influx of new people would have different social impacts such as mixture of culture, increase in insecurity cases and school dropouts increasing due to easy money.

The ESMP in the ESIA and RAP study reports have mitigation measures that have to be followed by the identified Contractor as well as the Proponent to adhere to.

6.6.8 Lack of Health Facilities

Discussions from the Women FDGs raised concerns over the number of health facilities in the area, noting that in some areas far from town centres, women have to travel long distances up- hill to access health care facilities, especially maternity services. The women of Ichichii and Makomboki proposed for the health facility to be better equipped.

The project contractor will construct a clinic with at least three female wards and provide at least two ambulances within the project area. This will not only serve the workers but also the local community and will be run for the benefit of the locals after the construction of the project is completed.

6.6.9 Education institutions in the project area

Discussions from various FDGs (Elders, Women and Youth) raised concerns over the distances covered by pupils and students in the area. The home to school distance remains far for most pupils. Some pupils travel as far as 3 km to school. This makes the students tired and lack concentration in class.

6.6.10 Communication network in the area

Concerns over the network jamming in the area due to limited telecommunication infrastructure were raised in the various FDGs across the community. Communication is poor in the area, especially *Safaricom* network due to the limited boosters in the area. The youth, especially, want communication improved.

6.6.11 Community roles

From the various FDGs in the project area, it was noted that in the community the roles of men and women are distinct. They each have the following functions. The summary of roles is as given below:

| Men | Women |
|--|--|
| <ul style="list-style-type: none">• Head of the family | <ul style="list-style-type: none">• Cooking for the family |
| <ul style="list-style-type: none">• Provides security for the family | <ul style="list-style-type: none">• Milking cows |
| <ul style="list-style-type: none">• Tea farming | <ul style="list-style-type: none">• Preparing kids for school |
| <ul style="list-style-type: none">• Dairy Farming | <ul style="list-style-type: none">• Transporting milk to the dairy |
| <ul style="list-style-type: none">• Pruning Tea | <ul style="list-style-type: none">• Farming |
| | <ul style="list-style-type: none">• Washing cloths |
| | <ul style="list-style-type: none">• Looking for firewood |

From the Elder's FDGs, it was also noted that according to the *Agikuyu* culture women are supposed to be hardworking and active in the *shamba*. It was considered against the norm for a woman who is not involved with activities in the *shamba*.

6.6.12 Community perception of economic ability

During the Elder's and Women FDGs the study team probed on the factors that the community used as indicators of economic ability. The members gave the following factors

- The size of the *shamba*;
- The number of livestock;
- The number of women one has;
- The produce (vegetation) that one has from their *shamba*; and
- The type of houses one has i.e. what materials have been used to make the house.

6.6.13 Grave sites

The study team probed on to understanding how the community bury their dead culturally. Members from the Elders' FDGs noted that most people buried their dead in homesteads. It was noted that there was a grave site that belonged to the county council in the area but people seldom buried their dead there. This was mainly due to the cultural beliefs carried by the community.

The study team probed on to understand; in the unfortunate occurrence that during construction some grave sites happened to be affected. Members responded that culturally death was a feared subject and in some instances regarded as a taboo to talk about it. They said that relocation of burial sites was a thing that was unheard of and suggested that incase the construction of the tunnel affected a grave site then the design of the tunnel should be changed to avoid it.

Members from the FDGs suggested that in a case of an affected grave site, the affected families should be approached on a case by case scenario and a favourable decision arrived upon consultatively, among the family or clan. However, the study team noted that since the tunnel will be between 15 to 215m underground, no impacts on graves are anticipated. Further, shallow earthworks are planned at/near rivers where chances of encountering graves are very slim.

6.6.14 Cultural sites in the area

The study team probed the various FDGs on the locations or presence of various Cultural sites in the area within Kangema and Kigumo. The members of the discussions noted that most of the cultural sites are close to or inside to forest, such sites are:

- ***Karia ka mbari ya hiti***: - which is a crater lake believed to have been created by a bomb in the First World War in the 20th Century. The lake/ water body was used for cultural events, located in Tutho. The lake is a preserved heritage site;
- ***Catholic Shrine in Tutho***: - This is a shrine built by the Catholics in start of the 18th Century (1700s).

However, neither of the two cultural sites will be affected by the NCT1 but may be affected by future tunnel developments to north Mathioya River.

The community was emphatic that any foreigner coming to the area with relation to the proposed NCT1 should respect the cultural significant sites in the area, including the *Mugumo trees* which are present in the project area in Kangema and Kigumo Sub Counties.

Ecological survey also established presence of *Mugumo tree*, *Ficus thonningii* in the project area. Plants of conservation significance on site will be identified by site environmentalist with assistance of locals and when encountered, these will be avoided as far as feasible as recommended in the ESMP.

6.7 Public Meeting Consultations

A total of 6 public community meetings were held along the project area in Kangema to Kigumo Sub Counties, with the help of the local administration. The breakdown of the meetings held is as shown in Table 6-6.

Table 6-6: Breakdown of Public meetings held during the ESIA and RAP stage

| No. | Location | Date | Time | Venue |
|---------------------------|--------------------------|--|----------|------------------------------|
| Kangema Sub County | | | | |
| 1. | Ichichii and Karura | Monday, 11 th August, 2014 | 2.00 PM | Ichichii Chief's Camp |
| 2. | Kiruri | Tuesday, 12 th August, 2014 | 2.00 PM | Kiruri Chief's Camp |
| Kigumo Sub County | | | | |
| 3. | Makomboki/ Kandenderu | Wednesday, 13 th August, 2014 | 10.00 AM | Makomboki Chief's Camp |
| 4. | Kangari/ Mairi | Wednesday, 13 th August, 2014 | 2.00 PM | Mairi Shopping Centre |
| 5. | Kinyona | Thursday, 14 th August, 2014 | 10.00 AM | AP- Line/ Kinyona Dispensary |
| 6. | Gacharage | Thursday, 14 th August, 2014 | 2.00 PM | Gikigie Primary School |

6.7.1 Objective of Public Consultation Meetings

Public consultative meetings were held in the six locations, listed above, along the project area. The objectives of these meetings were as follows:

- Awareness creation about the project to the community with respect to scope of the project; stakeholders of the project; development approach to be employed in the project; roles and responsibilities of the community and other stakeholders and role of GIBB Africa Ltd. in the project;
- Informing the community about the anticipated project management structure in relation to effective project operation;
- Setting and agreeing on the Cut- Off dates for the Resettlement Action Planning;
- Describing the Project foot- print from intake in Kiruri Location to the outfall in Makomboki Location in Kangema and Kigumo Sub County respectively;
- Explaining to the community on the different activities the study team will be undertaking in the RAP studies and further; explaining the communities role in the exercises thereof including the documentation required during the census and valuation activities;
- Informing the community on the environmental and social impacts of the project will be addressed;
- Getting feedback from the communities on their views on the project and issues of concern;
- Inclusion of the community in the development of the project at the planning stage;

6.7.2 Comments from the Consultations

A summary of the comments on the Northern Collector Tunnel- Phase 1 project raised from the public meeting is presented in the following sections. Minutes for the public meetings are presented in Appendix VI of this report.

(a) Abstracting water used by community

The community raised concerns over the abstraction of water from their area to serve people in Nairobi. They noted that several water users of the river who might be impacted. The study team informed the meetings, noting that hydrological study, currently being undertaken to determine water usage, demand and current flows in relation to what is to be proposed to be abstracted.

The study team further noted that the proposed water to be abstracted from the three rivers was flood flow only and not the normal or low flows. These intakes are designed in a manner to automatically shut/ close when acceptable flows are reached. This will ensure that the downstream users continue with using the water from the three rivers.

The community was also taken through the water projects that Athi Water Services Board (AWSB) has proposed for the project area especially the downstream areas such as: Kiharu, Kenol and Kandara.

(b) Social impacts of alien persons in the area

The community noted that previous Contractors who were undertaking constructions did a lot of social evils in the area as a result of them interacting with the locals, they were keen to know how this proposed project will ensure this will not happen again.

Response to this concern was that the Environmental and Social Monitoring and Management Plan (ESMMP) will be developed to act as a check for the required best practice and this will propose for a monitoring plan that will have to be strictly adhered to.

(c) Grievance mechanisms during and after Compensation

The community raised concerns over the conflicts over the transactions during the compensation period noting that it is important to create a committee from the community to settle any issues that would arise in the process of compensation.

The study team noted that after the studies will have been done, a committee for grievance solutions and implementation will be formed in close consultation with the local administration and Project Affected Persons (PAPs).

(d) Waste management

The community raised concerns over the management of the Cut-to-spoil that will come from the rock beneath. They asked on whether the murrum could be used on the feeder roads to improve the road network. They noted that it is important not to dump the spoils in people's shambas.

It was communicated to the community that there are areas of cut-to- spoil that have been identified, but in case the waste is usable for example on road development, they will be used

(e) Road destruction due to heavy equipment

The community raised issues on the impact of heavy trucks and equipments being carried on the existing road network in Kangema and Kigumo within the project area during construction. They noted that the roads are very important to the community as they use them to transport their tea.

The contractor will ensure the roads are maintained in proper condition and alternative traffic arrangements are made when necessary.

(f) Possible earth movement and faults

The community raised concerns over underground activities and impacts such as creation of a fault line after earthquakes (in case it happens). Muranga is a highly land slide prone area. the community had concerns over the vibration under the earth (soil layer) and the impact on the steep slopes of Kangema and Kigumo along the Tea belt.

A geological study, still under way, will determine the underlying rock structure and the possibility of a landslide due to vibration or cracks/ fault lines within the area. this will be communicated to the residence of the near by areas for safety purposes. In addition, the construction team will have a technical geologist to monitor the movements of the earth. The proponent will install monitoring equipment on the ground, sensitive to the movement of the earth so as to monitor the possibility of landslides or faults/ cracks.

(g) Interruption of school activities

Concerns were raised over the fact that construction might interrupt schooling and education activities in the area.

It was noted that consultations have been conducted with Education Stakeholders and they also noted that the schools could be impacted by the construction so the camp site will be located far from residential areas.

(h) Possible minerals underground

The community raised concerns over the possibility of the proponent finding or discovering Oil or such important minerals underneath a farmer's land. They asked on whether the farmer will be paid for the resources underground and whether the co-ownership will restrict him being paid compensation by the extractors of the oil.

The study team noted that in such a case, the people who will be responsible for extraction of such resources will communicate with the community of the developments and intended plans. The proponent of the NCT is interested in the construction and operation of the tunnel.

(i) Relocation

The community raised the issue of forceful relocation from the top of the Tunnel. The Study team responded by informing the meetings that the project follows World Bank standards as well as the letter of the Law of the Land. Forceful relocation cannot be considered at this project, the reason we are conducting the RAP is to identify, inform and collect concerns from those affected.

The proposed tunnel may cross through Makomboki Secondary Schools in Makomboki Location according to the initial walk through by the study team; will that lead to the relocation of the education institution?

In case of any resettlement whatsoever, the right and legal procedure will be adhered to for the same. There will be proper communication on the specific affected parcels after the survey. The full details of resettlement and compensation is defined in the RAP reports.

(j) Mediators and crooks during the Compensation process

It is important that the proponent (AWSB) to ensure that all payments or transactions on the given parcels to be done directly to the owner and/ or the administrator of the land at the time of compensation. The community does not want any crooks that will come in the name of broking or mediating between AWSB and the land owner.

No mediators will be given the authority by the client to conduct any activity for either the compensation or other processes during the project. To ensure transparency during the

process, identification documents will be taken and given to the PAPs in the affected land parcels.

Only the names on the list to be generated after the survey will be compensated, depending on the calculated costs. The community leaders including chiefs, elders, and headmen will accompany the enumerators for order of work. The mechanism of compensation and entitlement matrix will be publicly disclosed.

(k) Absentee PAPs

The community requested to know how those members of the public whose land or property is within the proposed wayleave for acquisition will be reached for details.

The relatives, community and the local administration were requested to pass information to the persons who they know have been affected to be available on their property on the day of assessment. The community requested that absentee farmers be represented by their family members, neighbours or the village elder who have to sign an agreement on the administration of the compensation payment.

(l) Possible flooding/ damage due to excess water

The community raised concerns of the possibility of flooding at the Githika River due to the excess water added by the Tunnel. The excess water may cause damage to crops and possibly cause injury or fatality in the case of children in the area.

The hydrologist did a study at the proposed outfall site and the land parcels likely to be affected by the overflowing water will hence be compensated for i.e. a buffer zone will be identified and safety precaution taken into account.

The community also raised the concern of whether the proponent will build/ construct a wall to prevent the back flow of water at the outfall as it enters the Thika Dam.

No wall will be constructed or erected; there will be proper construction of weir at the outfall area. To prevent soil erosion, gabions will be constructed.

(m) Land use and acquisition of the wayleave above the Tunnel

The community raised the issue of future land use on top of the NCT; noting that the tunnel may require a controlled land use. They were particularly concerned with the restrictions of the type of land use activity and structures, asking whether the wayleave will restrict farming activities.

Can the proponent develop a map showing the tunnel and the affected parcels in the area, from the beginning to the end? The study team will give the maps once the parcels are identified and super imposed on the land parcels from the beginning to the end of the tunnel.

The compensation makes the land parcels to be co-owned by the client and the owner thus any restrictions on the land use will be clarified by the client only after the study but farming is not one of the activities that are likely to be restricted in the area identified.

The community also raised clarification on the width of the Tunnel and the wayleave on the surface. The study team clarified the concern noting that the width is 3m along the tunnel. The proponent is considering co-ownership with the farmer/ land owner, therefore the co-owner can use the land, but in a controlled manner.

(n) Cut- Off dates

The community asked the study team of the intention of the cut- off dates and asked whether only the enumerated and valued structures as well as parcels affected will be compensated after the cut- off dates.

The cut-off date is the determinant of the assets and crops or trees to be compensated. The intention of the cut off dates is to limit the continued development of the land parcels affected by the Tunnel. The Valuer will only value the assets on the ground in between the dates agreed upon at the public meeting.

(o) Direct benefits from the NCT-Phase 1

The community raised the proposal that the areas between Kiruri and Makomboki should gain in one way or the other during construction and operation phases of the Tunnel. Some of the benefits proposed are:

- Improvement of education facilities in the area;
- Improvement on the roads; especially after the construction period is over by reinstating and improving on the existing situation. Examples given were: the bridge at Kiarurumo- Ichichii Road, connecting roads of Kangari- Kinyona, Kinyona- Njambini Road (19km) that would open the area to Nyahururu areas;
- Providing employment opportunities at the construction and operation phases to the locals of the area;
- Supporting the proposed water supply project development to Kiruri Location (Gatagwagwo Water Project) from the Ciainya River;
- To assist in building the Wangii Tea buying Center in Kiruri Location;
- Improving the health centre at Kinyona with clinical supplies and equipment;
- Assistance in finishing construction of the Bishop Gatimu Girls Secondary School in Kinyona; and the
- Improvement of the electricity coverage in the area.

The proposed support projects to the community in the project area were noted and were given to the proponent. It was noted that the road networks in the area is directly correlated with the livelihoods of the community in the area; this is because they use the roads to deliver tea, which is a major cash crop in the area. Priority should be placed on the improvement of roads.

(p) Health and Safety concerns during construction and operation

The community raised the issues of health risks of the persons/ workers working inside the Tunnel during construction. The safety of our youths is key and we would like an assurance of not being in danger while working under in the tunnel.

The contractor given the work to implement will have stringent Health and Safety rules to adhere to as a work place, both at the Contractor's camp and inside the tunnel as well as any other facility being built in the area. The proponent (AWSB) will have the responsibility to monitor and evaluate the activities of the contractor during construction. This will be to mitigate the risks identified by the ESMP in the ESIA and RAP study.

(q) Community Conserving the Aberdare Forest

The community noted that the people settled in the upper zone, at the base of the forest, are important to the conservation of the catchment. The community requested the proponent (AWSB) to support the community initiatives and cooperation during the operation of the NCT so as to ensure sustainability of the supply of water from the water tower.

The study team as well as the client representatives in the public meetings responded to the request. The community conserving the forest along the edge of the forest are indeed important as they play a crucial role to the sustainability of the hydrological system that affects many people all over the Country. Proposals to cooperate and support the community activities will be considered.

6.8 Public Disclosure

A stakeholders' workshop was held on Thursday, 2 October, 2014 at Nokras Hotel, Murang'a Town. During this workshop, findings, conclusions and recommendations of ESIA report and findings of RAP socioeconomic survey were disclosed to stakeholders and the public and their comments received. Representation at the workshop and proceedings are discussed as follows.

6.8.1 Stakeholders Represented at the Workshop

Stakeholders represented in the workshop included, but not limited to the following.

Table 6-7: Stakeholders represented during the Workshop

| No. | Stakeholder | Representatives |
|-----|--|---|
| 1. | Ministry of Water, Environment and Natural Resources | <ul style="list-style-type: none"> Rep of Permanent Secretary- Ministry |
| 2. | Water Service Regulatory Board | <ul style="list-style-type: none"> Chief Executive Officer |
| 3. | Athi Water Services Board | <ul style="list-style-type: none"> Chairman; Chief Executive Officer; Technical Managers; Senior Project Engineers; Environmentalist. |
| 4. | Tana Water Services Board | <ul style="list-style-type: none"> Technical Manager (PSM). |
| 5. | Water Resources Management Authority | <ul style="list-style-type: none"> Sub Regional Manager; Service Water Officers (Monitoring and Water Rights). |
| 6. | Nairobi City County Government | <ul style="list-style-type: none"> Chief Officer Water, Energy and Natural Resources |
| 7. | Development Partners | <ul style="list-style-type: none"> Senior Water Resource Specialist- World Bank Environmental Specialist- World Bank; Senior Specialist -<i>Agence Francais de Development (AfD)</i> |
| 8. | Member of Parliament | <ul style="list-style-type: none"> Personal Assistant to the MP Hon. Kangata Personal Assistant to the MP Hon. Kariuki |
| 9. | Vision 2030 Secretariat | <ul style="list-style-type: none"> Director |
| 10. | County Government of Muranga | <ul style="list-style-type: none"> Members of the County Assembly (Kinyona and Kanyanyaini Wards); C.E.C Infrastructure; C.E.C Water Environment and Natural Resources and Tourism. |
| 11. | Ministry of Interior and Coordination of National Government | <ul style="list-style-type: none"> County Commissioner- Muranga; Deputy County Commissioners- Muranga; Assistant County Commissioner- Kangari; Assistant County Commissioner- Kigumo; Chiefs and Ass. Chiefs from Kiruri, Ichichii, Gacharage, Kinyona, Mairi, Kangari, Makomoki Locations |
| 12. | Water Services Providers | <ul style="list-style-type: none"> Muranga South Water and Sanitation Company; Muranga Water and Sanitation Company; Kahuti Water & Sanitation Company; Gatamathi Water And Sanitation Company; Gatanga Community Water Scheme |

| No. | Stakeholder | Representatives |
|-----|--|---|
| | | <ul style="list-style-type: none"> Nairobi City Water and Sewerage Company Limited; Ruiru-Juja Water and Sewerage Co Ltd.; Kiambu Water and Sewerage Co Ltd. (KIWASCO); Karuri Water and Sanitation Co Ltd. (KAWASCO); Mavoko Water & Sewerage Company (MAVWASCO); Oloolaiser Water and Sewerage Company; Kikuyu Water Co Ltd. |
| 13. | Project Affected Persons (Community Representatives) | <ul style="list-style-type: none"> Community members from Kiruri, Ichichii, Gacharage, Kinyona, Mairi, Kangari, Makomoki Locations |
| 14. | Project Design Engineer | <ul style="list-style-type: none"> SMEC Consultants |
| 15. | Project Environmental Study Team | <ul style="list-style-type: none"> GIBB Africa |
| 16. | Church Representatives | <ul style="list-style-type: none"> Reverend from ACC&S Churches |
| 17. | Kenya Tea Development Authority | <ul style="list-style-type: none"> Officers from Makomboki and Gacharage Tea Factory |
| 18. | Ministry Departmental Representatives | <ul style="list-style-type: none"> Department Heads of key ministries in Muranga County |
| 19. | Kenya Rural Roads Authority (KeRRA) | <ul style="list-style-type: none"> Representative Officers |

Register of the stakeholders represented in the workshop are attached in Appendix VI of this report.

6.8.2 Comments from the Opening and Closing Sessions

The disclosure workshop was programmed in a manner to inform the participants of the study findings from the Environment and Social Impact Assessment (ESIA) Study. Various speeches were read as an introduction. Table 6-8 gives the summary of issues brought out by the different speakers in the opening and closing sessions from the different speakers.

Table 6-8: Summary of issues in the opening and Closing Remarks

| No. | Stakeholder | Remark |
|-----|--|--|
| 1. | ENG MALAQUEN MILGO: -Chief Executive Officer Athi Water Services Board | <ul style="list-style-type: none"> Described the Project components and its location; AWSB's commitment to environmental and social management of the impacts of NCT including: <ul style="list-style-type: none"> Compliance with the provisions of EMCA 1999 as well as World Bank's environmental and social safeguards; Partnership with relevant agencies for catchment protection; Local community benefits including hand-over of infrastructure at the end of the project and development of a community water project in the project area; Management of resettlement impacts through a resettlement action plan (RAP)4; Recognition of the importance of the |

| No. | Stakeholder | Remark |
|-----|--|--|
| | | <p>disclosure workshop as a platform for the team to receive feedback from the affected community and stakeholders;</p> <ul style="list-style-type: none"> ○ Appreciation of support from development partners and Murang'a County Government and the participation of stakeholders in general. |
| 2. | Eng. Robert Gakubia: - Chief Executive officer, Water Services Regulatory Board (WASREB) | <ul style="list-style-type: none"> • Environmental issues take a long time to manifest hence it is important to conduct ESIA so as to identify the impacts early enough and plan to manage them; • He recognized AWSB's commitment to stakeholder engagement. He urged Athi Water to adequately consult the County Government of Muranga to ensure smooth handover of the proposed facilities to the County Government. |
| 3. | Eng. Michael Ngari: -Chief Officer Water, Energy and Natural Resources; Nairobi City County Government | <ul style="list-style-type: none"> • The Project was not just for Nairobi but for the good of the people in Murang'a; • Its important to remember the lessons learnt from Ndakaini Dam which led to the need for development of a community water supply for Murang'a. |
| 4. | Dr. Rafik Hirji: -World Bank | <ul style="list-style-type: none"> • The NCT project is important for Kenya, Nairobi and 13 Satellite towns, and local communities who will all benefit from new additional water supplies and related benefits; • The ESIA is important to provide data, information and knowledge for informed decision making on the design and operations and environmental management of the project; • It is intended to open up the project planning and design decision making process; • Preliminary environmental issues were reviewed at the Master Plan Level but the ESIA is expected to provide details on these issues; • The project aims to benefit not only the end users of water, but also more importantly, the communities around the project site. |
| 5. | Mr. Remy Fritsch: -Agence Francais de Development (AfD) | <ul style="list-style-type: none"> • AfD has been investing in the existing water system in Nairobi; • It is important to minimize the impacts of the project on the environment. |
| 6. | Peter Kungu: -Chairman AWSB Board | <ul style="list-style-type: none"> • Water sources for Nairobi are in Murang'a, Nyandarua and Kiambu Counties hence the need for collaboration with the National Government to protect these sources; • AWSB is committed to dialogue for healthy discussions and feedback to inspire progress for the good of all stakeholders. |
| 7. | Eng. Kuria Gatere: -Representing Principal Secretary (PS), Ministry of Environment, Water and Natural | <ul style="list-style-type: none"> • The Ministry has a mandate to develop water resources in a sustainable manner; • The Ministry has put the necessary |

| No. | Stakeholder | Remark |
|-----|---|--|
| | Resources | mechanisms to monitor the implementation of this project |
| 8. | Hon. Charles Mwangi: -MCA Kinyona Ward, Murang'a County | <ul style="list-style-type: none"> • Article 43 of the Constitution gives everyone the right to water; he therefore stated that the people of Murang'a cannot deny any citizen of the country water. • He informed the meeting that there are issues that the County representatives have identified including: <ul style="list-style-type: none"> • (1) Potential increase in production of tea, which can be addressed by partnership of the county with the tea factories to produce electricity through Ndakaini Dam; • (2) Request to include the road network in the area (28km) into the project for improvements; (3) re-assurance from WRMA (chairman trade and industries Muranga County Assembly) that the project will not affect the proposed County bulk company: irrigation, domestic and export to Machakos; • (4) Domestic water supply in muranga county is only 33%, expect increase to 70% from the project as informed by AWSB. However, this percentage does not cover people of upper Kangema, Kigumo and Gatanga (communities adjacent to the weirs and upstream that do not have water). • (5) Consider people from these 4-5 wards for employment by the project, including capacity building and technical education; It is important to have capacity building programmes for PAPs to educate the community of the financial impacts of compensation and effect on livelihood; this was in reference to cases in Guchugu and Ndakaini, in terms of financial literacy. (6) expressed county's commitment of planting over 20million trees to the 4 areas upstream with socio-economic benefits e.g. fruit trees: avocado, macadamia; the proponent should look at supporting the communities on the upper areas of Kangema, Kigumo and Gatanga who protect and conserve the water catchment areas. Currently water supply to the area is limited due to intakes being built at lower levels in altitude, limiting the gravitation of water supply.. He also informed the meeting that WRUAs and schools can assist in these projects. |
| 9. | Ms. Kula Hache: -County Commissioner, Muranga County | <ul style="list-style-type: none"> • AWSB to extend benefits to the local community; • Youth and women should be empowered so that they can conserve catchment areas and the forests which will keep them busy and reduce crime. • The ESIA team engaged stakeholder to the grassroots level and hopes that the feedback from these groups was taken seriously, adding that she urges attendees to |

| No. | Stakeholder | Remark |
|-----|--|--|
| | | <ul style="list-style-type: none"> • participate actively; |
| 10. | Hon. Peter Kirungi– MCA, Kanyenyaini Ward and Leader of Majority in Muranga County Assembly | <ul style="list-style-type: none"> • He recognized that they are proud that Muranga is a custodian of one of the biggest resources– the water tower; • It is very important to support Nairobi, it is equally important that water as a resource should benefit the local community; • People at the source live at the highest point thus unable to access water; therefore there is a need for another project in the upper reaches of the project area to supply water to these communities; • There is need to maintain the forest, by planting indigenous trees inside the forest. The project should provide support to the community next to the forest to facilitate catchment management. |
| 11. | Eng. Amos Njoroge, C.E.C Infrastructure, Murang'a County Government | <ul style="list-style-type: none"> • Murang'a has one million people within the sub-counties and five water companies. The correct position is 38% coverage of water supply in Murang'a County. • He appreciated the proposals of water projects to the County in Murang'a and Gatanga Water Supply Projects coming to about one billion shillings; • There is a need for AWSB to meet at the County Offices to ensure that the coverage is good; • He requested that riparian rights for people downstream also be considered and Q95 to be confirmed by the team to avoid pressures on the scarce resource; • Environmental conservation is also paramount to ensure that programs are set up and run for sustainability for resource use; • Waste (spoils) from the tunnel excavation be given to the County to be used in upgrading the roads in Murang'a; • The issue of abstraction rights was well articulated. However, on development of infrastructure he wished that more specific information is provided to avoid duplication of allocation of funds for their development by the County Government; • Compensation is a critical issue and has also been well articulated; he noted that the findings from the RAP are disclosed at community level to avoid protracted grievances after compensation in the event of accidental damage. |
| 12. | Hon. Muiruri Maina, C.E.C Water Environment and Natural Resources and Tourism, Muranga County Government | <ul style="list-style-type: none"> • Gave apologies from the Governor, noting that he felt that the two Executives can handle the matters arising and can represent him accordingly; • He urged the project to take into account all the issues that are raised with honesty; the RAP implementation process should |

| No. | Stakeholder | Remark |
|-----|-------------|--|
| | | <p>therefore be handled in a transparent manner;</p> <ul style="list-style-type: none"> • There is need for environmental management programs including tree planting, improvements to sewerage and solid waste management. |

6.8.3 Comments from the stakeholders after the Plenary Session

Following the plenary session, with the different presentations from various study team members, the following is a summary of comments and responses from the community representatives in the workshop.

Table 6-9: Summary of comments and responses from the community representatives in the workshop

| No. | Question/ Comments | Response |
|-----|--|---|
| 1. | <p><i>Daniel Githu Mboi from Ichichii Location: (PAP).</i> Lives in Kikuyu but the land identified as a spoil site belongs to him. The piece of land you saw is mine. If it is used negatively it should be returned in its original state. Land rates should be based on demand and supply. What is the compensation formula? Has it been discussed with the people concerned?</p> | <ul style="list-style-type: none"> • Anastasia Ngatti: The compensation will be conducted at full replacement cost based on market rates. The Resettlement Action Plan (not discussed during this consultative session) contains the full details on compensation, eligibility and schedule. |
| 2. | <p><i>Josephat Rukenya (Kinyona Location).</i></p> <p>This is a wonderful project as the people in Nairobi are our brothers and sisters. The meeting has been informed that they will take flood flow. However, the flood flow is not enough as it is required here in Muranga. The intake for a proposed 149m/s downstream of the project area. There is also another project which will rely on the same flood flow. There are also some operational projects that require water. There is a fear that there will not be any flood flow for irrigation in the County for the projects in the pipeline.</p> <p>He has been to Lesotho where people have harvested water from the mountains and are selling it to South Africa. He proposes that AWSB consider damming at the Aberdares for water supply so that the water can be released during the flood.</p> | <ul style="list-style-type: none"> • Dr Nyanganga: The project is not taking all the flood flow as the project will leave other levels of flood from the river. He assured the meeting that compared to the maximum flood levels what the project is taking is negligible. • G Owuor: the study also proposed more stringent ecological requirements to ensure that water is not only available for human environment but also for aquatic life. • Eng. Muiruri called the attention of the meeting to the high levels of awareness on this project. This was because of the depth of consultations that started with the feasibility studies of Maragua dam. The decision making process was therefore long before they could get to this alternative of the tunnel. He assured the meeting that the project is not expected to have any long term impacts on the project area. The mandate of AWSB will also include Gaturi in terms of water supply hence |
| 3. | <p><i>Rose Njine -Gaturi Ward Representative</i></p> <p>She stated that Muranga County is in dire need of water and was worried that diversion of water by the project would result in loss of water supply for future needs. She inquired on the feasibility study findings and whether it confirmed that there would be no significant impact on downstream users. She inquired whether AWSB could tap water instead of drilling as this could lead to drying of wells. She proposed alternatives water sources such as rain water harvesting. She</p> | |

| No. | Question/ Comments | Response |
|-----|---|--|
| | personally rejected the NCT idea. | <p>the stakeholders there should rest assured that the proposed water project in Gaturi will cover that area.</p> <ul style="list-style-type: none"> On the issues by WRUA's AWSB has been working with Chania WRUA on climate resilience project as funded by World Bank. He informed the meeting that there is a possibility of including the Upper Tana WRUAs in the climate resilience project. |
| 4. | <p><i>Mr. Olenompoi -Enablers and Macro Vision 2030</i></p> <p>He felt it was important for the persons at Vision 2030 to be here as this is a flagship project and the partnerships formed here between county government, national government and donors are important for the attainment of project objectives.</p> <p>They are interested in how transformative the project will be for the people of Murang'a and Nairobi. He urged the meeting to take cognizance of the basic issues affecting individual households and persons, including compensation for land loss. He assured the community that the project is good for the stakeholders involved.</p> <p>They will also review the ESIA reports as he is cognizant of how important Muranga and Nyandarua are. He assured the meeting that the land take issues at Isinya will not be repeated in this project.</p> | <p><i>Comment, no response required.</i></p> |
| 5. | <p><i>Eliud Kimani, Makomboki Location</i></p> <p>He proposed that AWSB have a permanent office for receipt of complaints by the committee in the area as they are currently running through NCWSC. Inquired as to whether there will be an implementation committee with community representatives who would work as a link between AWSB and the community.</p> <p>The Maragua WRUA which is working within the project area and with a Chairman and Secretary, have not been facilitated by WRMA to ensure environmental management e.g. they do not have an office of funding. He would therefore request that some investment is made in tree planting and energy saving jikos. He would request for a sewerage system to handle pollution in Kangari Township as well as improve on sanitation standards.</p> | <ul style="list-style-type: none"> Eng. Muiruri: Community representation will be considered for adoption. Eng. Muiruri: Conservation issue will be brought forward. There is another project supported by the Bank – Water Security and Climate Resilience that can include Chania river into their program to ensure protection of the watershed. |
| 6. | <p><i>Rev Samuel Karanja- Church Minister, ACC&S</i></p> <p>Is concerned about the moral fabric of the</p> | <ul style="list-style-type: none"> George Owuor informed him |

| No. | Question/ Comments | Response |
|-----|--|--|
| | <p>community therefore he proposes that the churches and NGOs be involved in managing that. He also proposed that the church be involved in dissemination of information in the community as they have a wider reach.</p> <p>As the chairman of the education committee in the area, he proposes that criteria be put in place to ensure that school going children do not drop out of school in search of employment.. They have a population of students beyond 18 who may drop out to work since they have IDs.</p> <p>He urged that the project should start planting trees the earliest time probable since trees takes a lot of time to mature.</p> <p>He proposed construction of roads that would last longer as in the past; they wore out once the construction teams left the area.</p> | <p>that his request was noted and will be adopted. He said he will include in the report the recommendations that the church also be involved in the dissemination of information to the community.</p> <ul style="list-style-type: none"> • George Owuor further informed him that the hiring criteria will be established to avoid distracting students from the ongoing studies and labour laws will be applied during construction phase. • George Owuor requested the Engineers present to listen to questions being raised on the quality of the roads and ensure during this project the poor quality will not be repeated. |
| 7. | <p><i>Daniel Githu Mboi</i></p> <p>Is there any likelihood of tapping from Kihotie River next to Gikigie River?</p> | <ul style="list-style-type: none"> • George Owuor: The proposed project is abstracting from Gikigie River in that area. |
| 8. | <p><i>Peter Kariuki Njogu (County representative for people with disabilities)</i></p> <p>Will most of the water go to Nairobi and other areas or it will also be used by the people of muranga?</p> <p>As you involve other stakeholders, don't forget people with disability.</p> <p>Icharati ward has no water.</p> | <ul style="list-style-type: none"> • George Owuor: The abstracted water will be channelled to Kabete Reservoirs to serve Nairobi and the satellite towns due to the growing population and demand for water. • This was noted. GIBB collected contact information from Mr. Kariuki for further follow up. • To be covered under the community projects. |

Detailed minutes of the workshop are attached in Appendix VI of this report.

6.9 Project Awareness and support

The implementation of the tunnel development will have a far reaching effect on the social life of the people living within and around the project area. The socio-economic study conducted before the stakeholders' workshop assessed community perceptions and their views on the proposed project as expressed by the respondents.

In assessing the community's awareness of the proposed project, a majority of the persons within the project area noted that they were aware of it. This category of persons accounted for 81.95% of the surveyed population as shown in Table 6-10 below.

Table 6-10: Community project awareness

| Aware of project | Percentage response |
|------------------|---------------------|
| Yes | 81.95 |
| No | 18.05 |
| Total | 100.00 |

Of the surveyed population who noted that they were aware of the project, 40.60% got the information from their friends and neighbours. Another 26.32% got their information from government officials as presented in Table 6-11 below.

Table 6-11: Sources of information

| Source of information | Percentage response |
|-----------------------|---------------------|
| Friends / Neighbours | 40.60 |
| Government officials | 26.32 |
| No answer | 16.54 |
| ESIA / RAP study | 15.79 |
| Media | 0.75 |
| Total | 100.00 |

6.9.1 Project support

94.74% of members of the community support the project while only 5.26% of the community does not support the project as illustrated in Table 6-12. More than half of the surveyed population noted that the project will affect their operations as shown below.

Table 6-12: Project support and impact

| Project support | | Project impact | |
|-----------------|---------------------|------------------------------|---------------------|
| Support Project | Percentage response | Impact on current operations | Percentage response |
| Yes | 94.74 | No | 69.92 |
| No | 5.26 | Yes | 30.08 |
| Total | 100.00 | Total | 100.00 |

7 IMPACTS ASSESSMENT AND PROPOSED MITIGATIONS

7.1 Introduction

Implementation and operation of the proposed NCT1 Project is expected to have both positive and negative impacts on the bio-physical and socio-economic environment of the project area and beyond. This chapter presents the assessment of the anticipated potential impacts.

Impacts assessment involved impacts identification and study of their characteristics in terms of probability of occurrence, spatial boundary, duration and frequency of occurrence, reversibility of impacts, and magnitude as outlined below.

7.1.1 Impact Assessment Scoring

To systematically identify, predict, evaluate and determine the significance of impacts resulting from the project construction and operation, a generic criteria developed by Haug *et al* (1984) was adopted as presented in Table 7-1. Precautionary principle was used to establish the significance of impacts and their management and mitigation i.e. where there is uncertainty or insufficient information, the Environmentalist erred on the side of caution.

Table 7-1: Criteria for assessing significance

| | | |
|--|---------------|--------------------|
| SEVERITY OF IMPACT | RATING | CONSEQUENCE |
| <i>Insignificant / non-harmful / less beneficial</i> | -1/ +1 | |
| <i>Small/ Potentially harmful / Potentially beneficial</i> | -2/ +2 | |
| <i>Significant / slightly harmful / Significantly beneficial</i> | -3/ +3 | |
| <i>Great/ harmful / beneficial</i> | -4/ +4 | |
| <i>Disastrous/ extremely harmful / extremely beneficial</i> | -5/+5 | |
| SPATIAL SCOPE OF IMPACT | RATING | |
| <i>Activity specific</i> | -1/ +1 | |
| <i>Right – of – way specific (within right – way)</i> | -2/ +2 | |
| <i>Local area (within 5km of the project)</i> | -3/ +3 | |
| <i>Regional</i> | -4/ +4 | |
| <i>National</i> | -5/+5 | |
| DURATION OF IMPACT | RATING | |
| <i>One day to one month</i> | -1/ +1 | |
| <i>One month to one year</i> | -2/ +2 | |
| <i>One year to ten years</i> | -3/ +3 | |
| <i>Life of operation</i> | -4/ +4 | |
| <i>Post closure</i> | -5/+5 | |
| FREQUENCY OF ACTIVITY / DURATION OF ACTIVITY | RATING | LIKELIHOOD |
| <i>Annually or less / low</i> | -1/ +1 | |
| <i>6monthly / temporary</i> | -2/ +2 | |
| <i>Monthly / infrequent</i> | -3/ +3 | |
| <i>Weekly/ life operation/ regularly / likely</i> | -4/ +4 | |
| <i>Daily / permanent / high</i> | -5/+5 | |
| FREQUENCY OF IMPACT | RATING | |
| <i>Almost never/ almost impossible</i> | -1/ +1 | |
| <i>Very seldom / highly unlikely</i> | -2/ +2 | |
| <i>Infrequent / unlikely/seldom</i> | -3/ +3 | |
| <i>Often / regularly/ likely/ possible</i> | -4/ +4 | |
| <i>Daily / highly likely/ definitely</i> | -5/+5 | |

Table 7-2: Significance rating matrix

| CONSEQUENCE (Severity+ Spatial Scope + Duration) | | | | | | | | | | | | | | | |
|--|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|
| LIKELIHOOD (Frequency of activity + Frequency of impact) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 |
| | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 |
| | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 |
| | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 |
| | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 | 60 | 66 | 72 | 78 | 84 | 90 |
| | 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 | 70 | 77 | 84 | 91 | 98 | 105 |
| | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 | 80 | 88 | 96 | 104 | 112 | 120 |
| | 9 | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 | 90 | 99 | 108 | 117 | 126 | 135 |
| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |

Table 7-3: Mitigation ratings

| Significance Ratings | Value | Negative Impact Management Recommendation | Positive Impact Management Recommendation |
|-----------------------------|----------------|--|--|
| Very High | 126-150 | Improve proposed management | Maintain proposed management |
| High | 101-125 | Improve proposed management | Maintain proposed management |
| Medium - High | 76-100 | Improve proposed management | Maintain proposed management |
| Low - Medium | 51-75 | Maintain proposed management | Improve proposed management |
| Low | 26-50 | Maintain proposed management | Improve proposed management |
| Very low | 1-25 | Maintain proposed management | Improve proposed management |

The following is a detailed assessment of impacts anticipated to stem from implementation of Project. The proposed NCT Phase 1 is expected to have significant positive and negative impacts on the bio-physical and socio-economic environment of the project area. Below is a discussion of some of the potential impacts that will emanate from implementation of the NCT Phase 1 Project.

7.2 Positive Construction Impacts

Anticipated positive impacts from implementation of the NCT1 project will include but not limited to:

7.2.1 Employment and economic opportunities

The construction phase of NCT1 will require direct recruitment of significant numbers of people to work with the contractor (s). This will include both skilled and unskilled labour that will be engaged for about 40 months. Man hours to be provided by non technical staff alone have been estimated at 4,100 hours. Indirect economic opportunities will also be created through persons selling different wares to the construction staff domestic requirements. These will improve economic situation in the project area and temporarily reduce unemployment levels.

It is projected that there will also be an influx of new people into the project area in search for employment. An increase in population of this magnitude will create a corresponding increase in demand for goods and services such as food for construction workers, housing, healthcare and need for transport. These needs will be satisfied by people living within the project area where local women will provide food vending services, homes will rent out accommodation spaces for the new population and shops will also benefit from increase of sales. All these avenues are bound to create new employment opportunities.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|-----------------------|
| Severity of impact | +4 |
| Spatial scope of impact | +5 |
| Duration of impact | +4 |
| Frequency of activity / duration of activity | +5 |
| Frequency of impact | +5 |
| Result | +130 Very High |

The proponent should emphasize the use of local unskilled labour by any engaged contractor as far as feasible to enhance benefits for the local population.

Recommendations

- All construction workers should be employed and remunerated in accordance with the provisions of Kenyan labour laws and best international practices as contained in ILO and IFC Performance Standard 2: Labour and Working Conditions;
- Capacity building and training of men, women and youth on specialised labour that will be required during construction;
- Gender mainstreaming should be implemented during the recruitment process of workers to work in the construction process;
- Spreading projects administrative units such as Contractors and Resident Engineers camps to areas that are not going to benefit directly from the construction works so as to facilitate distribution of economic activities;
- Inclusion of availability of jobs for the project and process for recruitment into the communications plan; and
- Establishment of a strong quota system of allocation of jobs for persons living in the projects primary zone of impact, secondary zone of impacts and other immigrant workers.

7.2.2 Improved infrastructure

NCT1 project design has proposed improvement of local access roads, associated bridges and new short roads to project work areas as part of enabling works for the purposes of executing the project. These will be an advantage to the locals as they will have improved transport and communication networks. Transportation of tea from the farms to the tea buying centres and factories will especially benefit and KTDA will for sometime incur lower cost in maintenance of roads in the project area. Transportation of timber from the project area will also be made easier with access to heavier trucks to the area made possible with improved roads.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|-------------------------|
| Severity of impact | +3 |
| Spatial scope of impact | +3 |
| Duration of impact | +3 |
| Frequency of activity / duration of activity | +3 |
| Frequency of impact | +5 |
| Result | +72 Low - Medium |

Recommendation

- Over and above the above noted benefits it is proposed that the contractor in liaison with the Chiefs and KTDA management in the project area identify roads that require upgrading and then embark on the exercise of their improvement where feasible;
- Where necessary, traffic management plan should be developed together with alternative arrangements / diversions; and

- AWSB should ensure that the concerned roads are also maintained throughout the construction period and any damages are made good before the contractor demobilises from site.

7.2.3 Development of marketing opportunities

Implementing the project will create increased demand for various construction equipment/plants and materials input including cement, reinforcement iron bars, fine and course aggregates etc. These will translate into expanded market for suppliers of the inputs at national and international levels. Though limited to construction period, the expanded market will have increased economic benefits to participating traders and associated government tax revenues.

Additionally, the development of a camp site by the contractor for the resident engineer, his workers and himself will increase population and settlement within these sites thus facilitating growth of urban centres. This will benefit the local community in the following ways:

- Development and increase in food market. The campers in the above mentioned sites will require supply of food making accessories and food, which will need to be supplied by the local residents;
- Increase requirement for construction materials which the contractor might source from the local hardware's;
- Develop the real estate market as the workers working at the construction site will need accommodation that will have to be provided by the local community;

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|--------------------------|
| Severity of impact | +4 |
| Spatial scope of impact | +5 |
| Duration of impact | +2 |
| Frequency of activity / duration of activity | +4 |
| Frequency of impact | +4 |
| Result | +88 Medium - High |

Recommendations

- To facilitate growth of existing urban centres the camp site will need to be located at a considerable distance far away from them in order to spur growth; and
- AWSB in collaboration with the local administration can facilitate the development of a police post next to the outposts to increase security thus encouraging investments and settlements.

7.2.4 Desirable Social Change

During construction phase it is anticipated that influx of some immigrants from diverse cultures into the project area will occur for the new employment and trade opportunities created. It is anticipated that there will be cultural exchange which will lead to adoption of new ways of life, such as: changes in ways of clothing; social interactions between the new members and members of the community; and introduction of new beneficial ideas. The construction camp will also be transferred to the community after the end of the construction period.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|-------------------------|
| Severity of impact | +2 |
| Spatial scope of impact | +3 |
| Duration of impact | +3 |
| Frequency of activity / duration of activity | +4 |
| Frequency of impact | +3 |
| Result | +56 Low - Medium |

Recommendation

- In consultations with the local administration through the Murang'a County government, identify the best use to which construction camp can be put once the constructor demobilises from site.

7.2.5 Knowledge Transfer

Tunnelling works are rare in Kenya with existing ones having been done several decades back. Project implementation will see a number of locals gain practical and hands on training in tunnel construction thereby facilitating knowledge transfer. Further, AWSB will partner with Murang'a University for knowledge transfer hence facilitating practical training of concerned participants.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|-------------------------|
| Severity of impact | +2 |
| Spatial scope of impact | +5 |
| Duration of impact | +5 |
| Frequency of activity / duration of activity | +2 |
| Frequency of impact | +3 |
| Result | +60 Low - Medium |

Recommendation

- Specialist training should be incorporated within the project implementation targeting local personnel for O&M implementers, occupational safety and health instrumentation and associated fields.

7.2.6 Income Generating Opportunities for Women

During construction phase women in the neighbouring community to the project sites will get an opportunity to start small income generating activities such as: sale of food to the construction staff; and opening up shops to sell basic necessities to the construction staff.

This will increase and diversify income streams for the communities hosting the project and improve socio-economic status of their families.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|-------------------------|
| Severity of impact | +2 |
| Spatial scope of impact | +3 |
| Duration of impact | +3 |
| Frequency of activity / duration of activity | +4 |
| Frequency of impact | +4 |
| Result | +64 Low - Medium |

Recommendations

- It is recommended that the Contactor in each site develop catering services premises with cooking allocation and dining area for use by the service women mentioned above and their staff. The site will be dependent on the number of workers each construction site has;
- It is proposed that potable water should be provided at the catering area through a Water Tank or stand pipe for sanitary purposes;
- Women who want to participate be advised to get clearance from local Public Health offices; and
- Sensitize participating women on sustainable use of firewood/charcoal undertake monitoring to avoid excessive tree cutting.

7.3 Negative Construction Impacts

The proposed project will be associated with a number of negative impacts including the following:

7.3.1 Loss of land and resettlement

The project will require land for construction of the wiers, shafts, inlet and outlet portals as well as the outfall. In addition to this, to maintain the integrity of the tunnel structure, any land uses likely to negatively impact the tunnel are prohibited. From discussions with the design engineer, these activities include sinking of boreholes, blasting and quarrying. To ensure that AWSB has total control of land uses above the proposed 11.8km tunnel, this report also proposes acquisition of a 3m wayleave above the tunnel alignment.

The total land take will translate to approximately 18.366 acres of which approximately 97.4% is private land under freehold tenure. As a result of this, a total of 177 households corresponding to 657 persons will be directly affected by the land take at household level while a total of 8 public facilities corresponding to 8 public institutions.

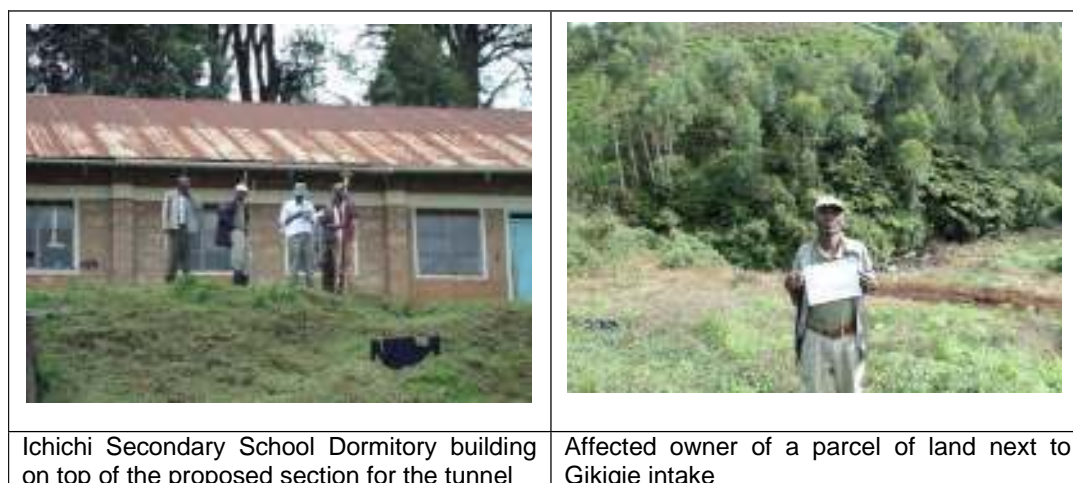


Figure 7-1: Land loss and resettlement

The 177 households include 174 land and asset owners and 3 tenants while the affected institutions are:

- Ichichi Secondary School;
- Ichichi community's football pitch;
- Ichichi Primary School;
- Gikigie Primary School;
- Ngecha Tea Buying Centre;
- Makomboki Primary School;
- Makomboki Secondary School; and
- Bible Fellowship Church.

Land is a fundamental factor for production for the PAPs as majority (over 70%) identified in farming as their primary source of income. The land uses that directly support livelihood streams among the PAPs are:

- Cultivation of cash crops such as tea and coffee;
- Cultivation of food crops for subsistence purposes;

- Planting of exotic trees, including woodlots for sale of fuel to tea factories and / or timber for construction in Murang'a Town and Nairobi City.

One (1 no) business structure will also be affected by the land take for the project. This structure houses 2 businesses namely a small hotel and a retail shop, which form the primary source of income for these tenant households.

The housing structures affected by the land take for the project include permanent (29%) and semi-permanent (71%) structures. Prompt payment of compensation to these PAP Units is therefore critical to ensure restoration of housing conditions.

The key public assets affected include a dormitory, sanitation facilities and land set aside for future development of facilities. Majority of these institutions requested for in-kind compensation which would greatly assist in securing continued service provision by these institutions

Impact Analysis Matrix

| | |
|--|------------------|
| <i>Impact without Mitigation</i> | |
| Severity of impact | -4 |
| Spatial scope of impact | -2 |
| Duration of impact | -5 |
| Frequency of activity / duration of activity | -5 |
| Frequency of impact | -5 |
| Result | -110 High |

A Resettlement Action Plan Study was conducted for the project with active participation by the PAPs at household level and key stakeholders at county level. An extract of the proposed entitlement matrix developed under the RAP Report is presented in Appendix VIII of this report.

Recommendation

- Implement the RAP to enable compensation payment and resettlement of PAPs prior to the contractor taking possession of any construction site.

7.3.2 Geological and seismic hazards

From reviews of baseline environment, the general project area is known for landslides. It is predisposed by its steep terrain, soil types and high rainfall. Construction activities especially portal earthworks and underground tunnelling which may at times deploy explosives may aggravate landslide hazards and also expose the project area to seismic hazards like tremors. Landslides may not only affect settlements and farms but may also affect the tunnel during the operation phase. Some severe damages including collapse of tunnel structures may occur in adverse situations.

However, from review of specialist geotechnical analysis conducted on the project area and application of best tunnel design standards, the project's implementation is not anticipated to aggravate these hazards and the predicted impacts are hence rated as moderate.

In addition, Geotechnical monitoring will be undertaken through Excavation Performance Review (EPR) system to continuously monitor the Geotechnical stability during the construction phase using appropriate instrumentation. Monitoring instruments will be installed within the excavation and on structures in order that the design assumptions and design models can be verified. The monitoring system and the results obtained from it will provide an early indication if encountered conditions are more adverse than those assumed in the design. This will allow timely and appropriate modification of the construction method or proposed support system to be implemented.

The purpose of the EPR is to define any requirement for the implementation of a revised support arrangement for the underground works that is designed to prevent ongoing deformation. Three Trigger Levels shall apply during the tunnel excavation as follows:

- Alert;
- Alarm; and
- Action.

The limiting measured rock displacements for each Trigger Level and each Excavation Class have been estimated within the design and the EPR procedure is summarised below.

| EPR criteria | Required action |
|---|---|
| Trigger level for instrumentation reached | When the recorded movements obtained from the deformation monitoring system reach the assigned trigger levels the EPR commences: <ol style="list-style-type: none"> 1. The Engineer shall be informed immediately; 2. The magnitude of observed deformation shall be checked; 3. The frequency of monitoring shall be increased as required; 4. An assessment/investigation of possible causes of exceedance undertaken; 5. Engineer and Contractor decide on the need for and extent of any modifications or action required; and 6. Ongoing review of excavation performance during and following implementation of any modifications and actions to confirm effectiveness. |

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|----------------|
| Severity of impact | -5 |
| Spatial scope of impact | -4 |
| Duration of impact | -2 |
| Frequency of activity / duration of activity | -1 |
| Frequency of impact | -2 |
| Result | -33 Low |

Recommendations

- In addition to the above measures, formulate an emergency communication plan for alerting the local community where the need arises. The plan should include community emergency trigger thresholds, clear protocol and roles for notification and follow-up actions.

7.3.3 Impacts on Soils

(a) Soil erosion and increased sedimentation

The hilly terrain and heavily weathered volcanic soils in the project area predisposes it to soils erosion. Major earthworks will take place before and during construction including: cutting new roads, repairs to existing roads; works at the intakes, outfall, adits and tunnel construction during the. Spoil materials from these activities will also be stockpiled in the locality either on hilltops or on their slopes. These are bound to result in significant amounts of loose soil materials prone to erosion through surface runoff, especially during rainy seasons.

The eroded materials and sediments from earthworks and stockpiled spoil may readily find their way into the numerous streams through surface run-off if not properly controlled. Unprecedented increase in sediment loads in the rivers can affect both riverine aquatic life and other uses (including downstream domestic usage and livestock watering) downstream the intake works areas. Though limited to construction period, the impacts could be amplified and recur even in post-construction period if new erosion susceptible areas are opened up.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|----------------|
| Severity of impact | -3 |
| Spatial scope of impact | -3 |
| Duration of impact | -2 |
| Frequency of activity / duration of activity | -2 |
| Frequency of impact | -3 |
| Result | -40 Low |

Mitigation

- Contractor must ensure clear delineation of construction work areas to avoid unnecessary vegetation clearance and soil loosening;
- The contractor must implement planned erosion control measures to avoid erosion in areas that are prone to erosion, e.g. steep slopes and drainage lines;
- Topsoil stockpiles will be vegetated to prevent erosion;
- No topsoil to be utilized during any construction activity;
- Implement soil conservation measures at stockpiled sites;
- Where feasible, topsoil must be reinstated and rehabilitated on top of sub soil;
- All excavation works must be properly backfilled and compacted;
- Ensure downstream water users are informed about any unprecedented release of heavily silted water into the river;
- Where possible, construction activities should be scheduled to occur outside of the rainy season, to reduce the anticipated volume of runoff during construction; and
- Sediment traps and barriers must be employed due to steep terrain.

(b) Soil pollution

Construction will involve use of large fleet of machinery powered by fossil fuels and requiring regular maintenance with other hydrocarbon-based substances like oil, grease etc. Improper handling or accidental spillage of these is likely to result in pollution of any receiving soils. This will affect both biophysical and chemical properties of the soils rendering them unsuitable for agricultural production as currently practised.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|-----------------------|
| Severity of impact | -3 |
| Spatial scope of impact | -2 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -4 |
| Frequency of impact | -3 |
| Result | -56 Low-Medium |

Mitigation

- No vehicle/plant maintenance shall take place on undesignated site. In case of emergency, a drip tray shall be used to avoid diesel and / or oil spills;
- Concrete mixing shall not be done on bare soil. Concrete must be mixed on mortarboards, a large metal sheet or concrete slab. The slabs for concrete mixing shall be removed on completion of construction works;
- Excavated material shall be stockpiled at a demarcated site, within the construction zone;
- Once the construction activities have terminated, rehabilitation

(c) Soil compaction

Project construction activities like adits, intake works and portal earthworks, associated traffic especially the heavy trucks and earth movers within the project area will lead to compaction of the soil structure. The net result would be reduced percolative and infiltrative capacity of the soil leading to reduced soil-water balance in the affected soils. However, this is anticipated to affect mainly the intakes and outfall area and areas near adit locations.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|----------------|
| Severity of impact | -2 |
| Spatial scope of impact | -2 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -3 |
| Frequency of impact | -4 |
| Result | -49 Low |

Mitigation

- Vehicles must be kept on existing/designated roads/tracks where possible;
- Minimize compaction during stockpiling by working the soil in the dry state;
- Rip compacted areas to reduce runoff and re-vegetate where required;
- All topsoil and other soil profiles must be managed strictly.

7.3.4 Pollution of (surface and ground) water resources

Apart from the project Target Rivers, many other small streams exist in the project area. During the construction, sediment from the earthworks, wet cement, detergents, paints and other chemicals, accidental oils and fuels spills and leaks from deployed equipment may find their way into the river through surface run-off if not properly controlled. This will contribute to degradation of the river water quality and may affect the downstream users negatively. At worst, most aquatic organisms may be affected.

Impact Analysis Matrix

| | |
|--|-------------------------|
| Impact without Mitigation | |
| Severity of impact | -4 |
| Spatial scope of impact | -4 |
| Duration of impact | -2 |
| Frequency of activity / duration of activity | -3 |
| Frequency of impact | -3 |
| Result | -60 Low - Medium |

Mitigation:

- Implement Standard Operating Procedures (SOPs) for working in water, including checks on equipment condition (especially leaks of oils, fuel, hydraulics), refuelling protocols (at safe location away from water, availability of spill kits and knowledge of their use, and emergency spill procedures);
- Any on site/camp storage areas for fuels, oils or other liquid chemicals would be sited away from surface water drains. They must have an impermeable base and bund with a capacity of 110% and would not drain directly into the surface water drains. Where practicable, drainage from storage compounds would be passed through oil interceptors prior to discharge;
- Apply standard best practice site sediment control procedures (e.g. settling ponds and silt barriers) to minimise sediment in site drainage waters returning to the river;
- Ensure all staff and workers are fully aware of the limits to the site for each activity, SOPs, and emergency procedures;
- Ensure that all construction equipment and vehicles are serviced off site at licensed garages;
- Any contaminated soil should be handled properly as hazardous waste and removed from site for safe disposal; and
- Careful management of the sites and education of all construction staff would curtail the risk of pollution spills.

7.3.5 Changes in groundwater levels and flow

Tunnelling activities may lead to alterations of underground drainage and fracture flow. During the drilling, water inrushes may occur at fracture zones. Studies have shown that tunnels can lead to drying up of springs and streams leading to severe socio-economic and ecological effects such as the total disappearance of fish, amphibians and aquatic invertebrates in the dry stream sections. Several streams and rivers will be crossed by the tunnel (see section 3.1.4). However, no major fractures are anticipated and underground water is also not a major source of community water supply (only accounts for 2.26%).

Impact Analysis Matrix

| | |
|--|----------------|
| Impact without Mitigation | |
| Severity of impact | -2 |
| Spatial scope of impact | -3 |
| Duration of impact | -2 |
| Frequency of activity / duration of activity | -2 |
| Frequency of impact | -3 |
| Result | -35 Low |

Mitigation:

- Any shallow wells and boreholes affected by the project will need to be re-established during the project operation; and
- AWSB has proposed projects to supply piped water to the area covered by the project (see section 4.10).

7.3.6 Impacts from Construction camp

A construction camp for NCT Phase 1 has been proposed near Irati River intake at coordinates X= 259955, Y= 9917739 in Kinyona location, Kigumo sub-county. The land belongs to Mr. Matthew Gichuhi and is currently under tea plantation. The construction camp will consist of site offices, workshops, stores, vehicle parking, and staff accommodation. The camp site is bound to have high human activity posing the problem of hygienic disposal of sewage, household waste and refuse as well as general insecurity challenges. Others include waste from construction material areas and fuelling stations. All these are potential pollution agents for surface and underground water and soils and need adequate management.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|-----------------------|
| Severity of impact | -3 |
| Spatial scope of impact | -3 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -4 |
| Frequency of impact | -4 |
| Result | -72 Low-Medium |

Mitigation:

- Careful planning of construction camp;
- Any contractor's camp should have a comprehensive waste management and sanitation plan and facilities commensurate with population of workers and activities in the camps;
- Any storage tanks and equipment should have correct labels and Material Safety Data Sheets;
- Adequate Emergency Response Plan should be in place in the camps;
- The contractor should employ best practice management "housekeeping" (site cleanliness, waste disposal etc.) at all times;
- The contractor's facilities should be completely removed from site after use and the land restored to its previous condition or better;
- Ensure full compliance with the EMCA waste management (2006) and Wetlands, River Banks, Lake Shores and Sea Shore Management regulations (2009) and compliance with relevant ESMP items; and
- AWSB in collaboration with the local administration can facilitate the development of a police post next to the camp area to increase security.

7.3.7 Oil spills

There may be accidental oil spills from construction machinery and vehicles through refuelling and also the construction of permanent and temporary fuel storage facilities. The most likely impact will be contamination of soil and surface waters. Contaminated soil is injurious to plant growth and must be removed. Contamination of water is potentially more serious since pollutants may move fast destroying aquatic life and rendering water unsafe for domestic and livestock use.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|-------------------------|
| Severity of impact | -5 |
| Spatial scope of impact | -4 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -2 |
| Frequency of impact | -3 |
| Result | -60 Low - Medium |

Mitigation:

- Vehicle maintenance should be done on purpose-built impervious concrete platforms with oil and grease traps;
- Any on site oil and fuel storage must be well banded and located away from natural drainage and stormwater channels;
- Ensure that all equipment are in good condition, clean and free from leaks;
- Oil spill containment and cleanup equipment should be kept at the contractor's camp. The Contractor shall construct oil skimming tanks at the locations directed and in accordance with details approved by the Engineer. Oil recovered from the skimming tanks shall be stored in drums and removed from the site for safe disposal.
- Contractor shall monitor effluent discharge from the oil skimming tanks. Effluent discharge shall not exceed 25 mg/litre or the limit specified by the NEMA.

7.3.8 Shifting of unskilled labour force from agriculture to construction

Implementation of the project will create a huge demand for unskilled labour lasting about 40 months. When wages offered are considerably higher than prevailing rates, this can result in significant shift of the unskilled labour currently engaged in tea picking to tunnel construction activities. Tea farming is the main economic activity in the project area and such shifting can result in reduced tea picking of ready tea leaves and delivery of fresh tea leaves to local factories leading to reduced output and associated losses to farmers and in export revenues. Similar impacts have been experienced in the area before e.g. during the construction of Thika dam as was also reminisced by some stakeholders consulted. However, Hiring at the local level is not expected to cause any overheating in the local labour market or to significantly affect the availability of casual workers to serve the tea plantations and other businesses in the Kangema and Kigumo.

Additionally, wages offered at the construction sites may lure some in the school-going age-groups who may then opt to drop out of school to gain from the project. When employment is granted by the contractor, this can lead to temporary increase in school drop-outs in the project area over the construction period lasting about three years.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|----------------|
| Severity of impact | -2 |
| Spatial scope of impact | -3 |
| Duration of impact | -2 |
| Frequency of activity / duration of activity | -4 |
| Frequency of impact | -3 |
| Result | -49 Low |

Mitigation:

- The contractor should be encouraged to offer wages within the prevailing market rates; and
- Contractor must abide by local labour laws international best practice and avoid any employment of underage individuals.

7.3.9 Impacts on Aquatic Fauna

(a) Sedimentation of stream water

During constructions of intakes, weirs and fish passes, adits and outfall the removal of bank/instream soil and vegetation clearing will cause sedimentation affecting fish and aquatic invertebrates sensitive to changes in the water quality parameters such as, increased turbidity, changes in temperature etc. Fresh water fish and some other aquatic organisms are unlikely to live and breed well in such modified areas. In

addition, sediment eroded from stream banks may be carried further downstream where it is deposited, smothering eggs and invertebrates.

Moreover, extreme (too high) flow variations will increase sediment load from the project site, which inhibits percolation and lowers available oxygen. Sediment in the flow scours spawning beds for breeding species.

Fish species such as the mountain catfish *Amphilius uranoscopus*, caddisflies such as the *Hydropsyche sp*, the aquatic beetles that rely on vision to obtain food would be adversely affected as a result of sedimentation.

Poor visibility due to sedimentation of stream water (by construction activities) may affect hunting efficiency of otters who feed on fish and crabs.

Increased sediment load caused by eroded stockpiles may also occur during tunnel construction.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|----------------|
| Severity of impact | -2 |
| Spatial scope of impact | -3 |
| Duration of impact | -2 |
| Frequency of activity / duration of activity | -3 |
| Frequency of impact | -4 |
| Result | -49 Low |

Mitigation

- Monitor water flow during construction and maintain the minimum ecological requirement for all rivers to ensure water is available downstream all the time. Observe the minimum ecological flow after intake for R. Maragua and R. Gikigie to maintain the desired hydrological connectivity in the system (upstream-downstream), inundates critical habitats (e.g. riffles) and maintain low water temperature necessary for survival of the moderately flow-sensitive species found at this site;
- Ensure riverine protection through observing the 6-30m (Water Resources Management Rules, 2007) away from the river banks and planting of indigenous riparian trees to reduce sedimentation in particular of acidic Tea soils that will lower water pH; and
- Provide compensation and sediment channels in the weir as well as physical removal of sediment.

(b) Interference with fish movement/passage

During construction diversion weirs and water tunnels may create temporary barriers to highly mobile aquatic fauna unfamiliar with new surrounding until they adapt navigating across them. Long distant migratory fish such as *Anguilla bengalensis*, *Oncorhynchus mykiss*, *Salmo trutta* etc. may experience delays due to blocked passages, which depletes energy reserves and increases stress.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|----------------|
| Severity of impact | -2 |
| Spatial scope of impact | -2 |
| Duration of impact | -2 |
| Frequency of activity / duration of activity | -3 |
| Frequency of impact | -2 |
| Result | -30 Low |

Mitigation

- Minimize activities to areas of construction and initiate habitat restoration immediately after construction works are through; and
- Restore disturbed areas to near-to-nature to blend with the immediate environment.

(c) Reduced water flow

Instances of reduced stream are anticipated from diversions and retention at points during construction. These may destroy delicate microhabitats within the river and may result in loss of aquatic fauna particularly during the dry season. For example, the loss of stream riffles when there is no water flowing hence species adapted to riffle micro-habitats such as mountain catfish *Amphilius uranoscopus*, *Simulium* spp. are lost or forced to the pool areas. Also the flatheaded mayfly larvae *Afronurus harrisonii*, the stonefly larvae *Neoperla* spp., the marsh beetle *Helodidae* spp. which are excellent indicators of good water quality.

Imotile bivalve mollusks such *Pisidium* spp. which burry in sandy sediments will be highly affected since they cannot move to the new reduced water levels and have to adapt or wait heavy rains or become locally extinct. However, the impacts will be localised only affected minor stretches of rivers.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|----------------|
| Severity of impact | -3 |
| Spatial scope of impact | -2 |
| Duration of impact | -2 |
| Frequency of activity / duration of activity | -3 |
| Frequency of impact | -3 |
| Result | -42 Low |

Mitigation

- Shorten the periods of temporary river diversions as far as feasible; and
- Ensure sufficient compensation flow.

(d) Water contamination from Oil Spills and Leaks

To some extent discharge of toxic substances such as oil in the project construction site and their condensation in food chain may affect sensitive animals immediately; all living organisms may expire when the stream becomes unable to recover itself.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|-----------------------|
| Severity of impact | -4 |
| Spatial scope of impact | -3 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -3 |
| Frequency of impact | -3 |
| Result | -60 Low-Medium |

Mitigation

- Ensure adequate waste management plan is in place and in use from the onset of construction; and
- Oil spill containment and clean-up equipment should always be available at the construction site with trained response team.

(e) Modification of stream habitats

Some loss of breeding and nursery grounds for fishes and invertebrates (such as the freshwater crabs *Potamonautes* spp whose juveniles were recorded near macrophytes such as the *Cyperus* spp., *Polygonum* spp., etc) may occur. The area being considered for the project covers some potential breeding and nursery grounds for migratory fish e.g. gravel, boulders, macrophytes which are ideal breeding grounds for the *Barbus* spp. The potential loss of these grounds may be detrimental to the enhancement of the lower Tana River fisheries.

Otter dens in the bushes may be lost during land clearing for construction of fish passes and water tunnel. These prolonged disturbances may cause stress to the animals.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|----------------|
| Severity of impact | -3 |
| Spatial scope of impact | -2 |
| Duration of impact | -2 |
| Frequency of activity / duration of activity | -3 |
| Frequency of impact | -3 |
| Result | -42 Low |

Mitigation Measures

- Systematic search, capture and safe release of otters inhabiting the right of way (for the weir structures) and fish pass (involve mammal experts e.g KWS, NMK). Selective clearing and restoration of vegetation after construction

7.3.10 Loss of vegetation cover

Clearing of vegetation to allow for intake works, outfall and adit/portals will be inevitable. This will especially affect tea bushes and eucalyptus woodlots. Spoil locations have also been proposed in areas with common bushes and trees in attempt to avoid tea bushes wherever feasible. These will reduce area under vegetation cover. In the process, some isolated species of conservation significance (see Table 3-15) may also be impacted.

Further, the construction workforce and transport activities may also lure illegal logging of the identified plant species of conservation significance, some of which are highly valued for their hardwood. FGD also established that one of the identified species, *Ficus thoningii*, locally known as *Mugumo* tree is sacred is cutting it is culturally abhorred.

Impact Analysis Matrix

| | |
|--|----------------|
| Impact without Mitigation | |
| Severity of impact | -2 |
| Spatial scope of impact | -2 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -2 |
| Frequency of impact | -3 |
| Result | -35 Low |

Mitigation:

- Clearing of vegetation and trees should be strictly controlled and only done if its absolutely necessary through clear delineation of works areas;
- Sensitize workers on culturally significant Mugumo tree, *Ficus thoningii* and the need for its preservation;
- Compensate for affected tea bushes and tree/woodlots before construction works begin and allow for salvage of affected timber;
- Disturbed areas should be re-vegetated with locally occurring grasses, shrubs and indigenous trees soon after completion of each section;
- Where encountered, plants of conservation or cultural importance should be avoided as feasible;
- Contractor should establish and enforce code of conduct for its employees which must among others abhor illegal logging even from chance encounters of protected tree species within the project area; and
- The contractor must ensure compliance with Wildlife (Conservation and Management) Act, 2013 and sensitize employees on the same.

7.3.11 Spoil

Some 250,000 cubic meters of material will be excavated from the tunnel. These large quantities of soil may affect the surrounding environment if not adequately disposed. The excavated material is prone to erosion through surface water runoff, especially during rainy seasons and may even impede rivers meant for water supply. Spoil dumps left bare for long may be colonised by plants including invasive species.

Impact Analysis Matrix

| | |
|--|-------------------------|
| Impact without Mitigation | |
| Severity of impact | -4 |
| Spatial scope of impact | -3 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -3 |
| Frequency of impact | -4 |
| Result | -70 Low - Medium |

Mitigation:

- Maximise the re-use of excavated materials in the works as far as feasible to ensure that no permanent spoil dumps are created;
- Investigate opportunities to set up MOU for use of spoil material elsewhere by the county government (e.g. for road construction and rehabilitation);
- Properly dispose off the spoil in the identified by the design team and approved by the confirmed land owners;
- Care should be taken to avoid spoil location in land that could otherwise be used for productive purposes;
- Ensure the contractor formulate and implement erosion and siltation management measures at chosen spoil locations; and
- Collaborate with Murang'a County government to utilize some of the spoil materials e.g. in rehabilitation of local roads.

7.3.12 Waste Generation

Solid waste will be generated from various construction activities. These will include among others waste metals, packaging for construction materials, office wastes and disused materials. Liquid wastes may include runoff water contaminated with spilled oils from construction equipment and other construction processes. All these waste will need to be properly managed and disposed discretely so as not to pollute the environment.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|-------------------------|
| Severity of impact | -3 |
| Spatial scope of impact | -3 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -4 |
| Frequency of impact | -4 |
| Result | -72 Low - Medium |

Mitigation:

- The contractor shall formulate and implement suitable Waste Management Plan in line with Waste Management Regulations, 2006. The plan must cover both hazardous and non-hazardous wastes;
- For waste handling the contractor should provide litter collection facilities such as bins;
- Final disposal of the site waste should be done at a location that shall be approved by Resident Engineer in accordance with the Waste Management Plan after consultation with the relevant stakeholders, including the County Administration and local community;
- Contractor must ensure that all grey water runoff or uncontrolled discharges from the site/working areas (including washdown areas) to water courses should be contained and properly channelled;
- Any hazardous wastes generated must be handled appropriately and disposed of only by licensed hazardous wastes handlers only; and
- Ensure full compliance with the waste Management Regulations, 2006.

7.3.13 Air pollution

The principal air quality concern during construction will be dust. Dust will be generated during excavation works, batching plant operations and possibly from project borrow pits and quarries and during haulage of construction materials over distances. Airborne emissions will also be generated by combustion of fuel in vehicle and equipment engines.

The dust may cause respiratory complications to workers and nearby settlements. Fumes and carbon compounds from the equipment and machines inhibit visibility and form deadly compounds in the air. If inhaled, severe respiratory complications are imminent.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|-------------------------|
| Severity of impact | -3 |
| Spatial scope of impact | -2 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -5 |
| Frequency of impact | -3 |
| Result | -64 Low - Medium |

Mitigation:

- Construction materials and excavated soils should be covered during transport and storage;

- Water spraying should be done around the construction sites and routes during dry seasons;
- The contractor should conduct workers training on management of air pollution from vehicles and machinery;
- All construction machinery should be maintained and serviced in accordance with the manufacturers specifications;
- Exhausts and ductwork from plant/equipment must be located away from air intakes, windows, enclosed areas and public areas;
- The contractor should conduct workers training on dust minimisation techniques; and
- Dust generating activities should not be carried out during times of strong winds.

7.3.14 Noise and vibration

Noise and vibrations will emanate from construction traffic, machinery, and tunnelling activities. This will affect those living within the vicinity of the project area (identified in the baseline information) and workers at the project site. Traffic noise also anticipated from materials and spoils haulage trucks especially along the used routes (note that many settlements are along the roads). Some materials like sand and ballast are not readily available in the area and will be sourced from distant locations about 100km away thereby spreading the likely impacts.

Tunneling will also give rise to a form of impact similar to vibration known as ground borne noise. This is low frequency noise which can be perceived in buildings above a tunnel in a manner similar to vibration. The land sections above which the tunnel are located mostly under agriculture or small trade centers and there are no sensitive sites exist above the tunnel alignment route. Some impacts from this source may however affect Ichichi primary school which is close to the Maragua intake works.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|------------------------|
| Severity of impact | -4 |
| Spatial scope of impact | -3 |
| Duration of impact | -4 |
| Frequency of activity / duration of activity | -4 |
| Frequency of impact | -4 |
| Result | -88 Medium-High |

Mitigation:

- Noise levels shall be kept within acceptable limits preferably as stipulated within the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) Control Regulations, 2009 and construction activities shall, where possible, be limited to normal working hours;
- Contractor must be required to monitor noise and vibration in sensitive locations above the tunnel (hospitals, teaching facilities, churches) and along the haulage routes to ensure the NEMA requirements regarding noise and vibration are met and if the standards are exceeded measures must be taken to reduce noise and vibration;
- Equipment should be maintained regularly to reduce noise resulting from friction;
- Workers exposed to high-level noise must wear personal protective equipment (PPE);
- Use of silencers on the construction plant, where applicable, should be encouraged;
- Residents in close proximity should be given at least 24 hours notification of any abnormal noise source e.g. planned blasting; and
- Institute a community complaints/redress mechanism to identify and respond to any unanticipated noise/vibration related complaints.

7.3.15 Cultural and archaeological sites

Presence of any physical cultural and historical sites within the project area was not established during socio-economic survey. However, presence of sacred *Mugumo* trees was

confirmed by ecological surveys and whenever encountered, these will have to be avoided as far as feasible. Chance finds of physical cultural and historical sites may occur during construction of the tunnel and such sites may be damaged by excavation activities.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|----------------|
| Severity of impact | -2 |
| Spatial scope of impact | -2 |
| Duration of impact | -2 |
| Frequency of activity / duration of activity | -3 |
| Frequency of impact | -3 |
| Result | -36 Low |

Mitigation

- Sacred *mugumo* trees encountered within the project area should be avoided wherever feasible. These should be identified by the contractors' environmentalist;
- Contractor should sensitize all staff on local cultures and discuss with local community whenever a mugumo tree has to be cut; and
- The contractor should develop and implement a chance find procedure in case archaeological sites are found during the construction process. Such procedure must incorporate liaison with the National Museum of Kenya.

7.3.16 Immigration and settlement

The promise of monetary reward during the construction phase of the project is going to attract immigrants to the project area. The projected increase in population will create more pressure on the existing social utilities such as medical centres in the project area. The new immigrants with diverse cultures will also expose the area to different Kenyan cultures; the project area is mainly inhabited by members of the Kikuyu community.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|----------------|
| Severity of impact | -2 |
| Spatial scope of impact | -3 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -2 |
| Frequency of impact | -4 |
| Result | -48 Low |

Mitigation:

- Monitor the trend of migration during the project implementation and adjust the required utilities accordingly.
- Engage a community liaison officer to facilitate smooth transition between cultures by sensitising workers on local cultures.

7.3.17 Social delinquency, HIV/AIDS and other sexually transmitted infections

From the consultations it was also noted that the HIV/AIDS prevalence cases in Kigumo and Kangema Sub-Counties are 5.2% and 5.6% respectively. During construction, the project is likely to bring in a significant population of new people in the project area. With this, chances are high that social delinquency and STI rates will increase. This is due to the fact that the workers and traders will have money to spend and some may use it to attract women from the project area in a bid to solicit for sex, thereby creating avenues for spread of HIV/AIDS and STIs. However, the proponent has incorporated the following as part of contract conditions to a successful contractor, thereby significantly reducing any likely impacts.

- **HIV-AIDS Prevention:** The Contractor shall conduct an HIV-AIDS awareness programme via an approved service provider, and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of the HIV virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals;
- **Information, Education and Communication (IEC) campaigns** by the contractor, at least every other month, addressed to all the Site staff and labour (including all the Contractor's employees, all Subcontractors and any other Contractor's or Employer's personnel employees, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behavior with respect to, of Sexually Transmitted Diseases (STD) - or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular;
- **Provision of Male Or Female Condoms** for all Site staff and labour as appropriate; and
- **Provision for STI and HIV/AIDS screening, diagnosis, counselling** and referral to a dedicated national STI and HIV/AIDS programme, (unless otherwise agreed) of all Site staff and labour.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|------------------------|
| Severity of impact | -4 |
| Spatial scope of impact | -3 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -5 |
| Frequency of impact | -4 |
| Result | -90 Medium-High |

Recommendations

- Ensure the contractor liaises with local public health officials and licensed NGO's within the project area in educating the community;
- Select appropriate construction camps locations away from concentration of schools and human settlements;
- Formation of peer groups from among the project staff to ensure continuity in training and awareness raising; and
- The contractor should ensure that the project workers are sensitised on the local culture.

7.3.18 Impacts on traffic volumes and tonnage

Project construction will elevate traffic frequency and volumes (over 600) of both light and fast moving and heavy and slower vehicle categories (see Appendix V for nominal numbers of vehicles involved) in the project area. These will cause some traffic inconvenience to the locals (mainly tea delivery trucks and matatus plying the area) and will also increase risks of traffic accidents given the numerous meanders and narrow roads. Some of the existing bridges may not be capable of handling the anticipated heavy trucks as their design might have not anticipated traffic of that nature and are thus bound to be dilapidated within a short duration.

It is notable that the proponent has incorporated improvements of the local roads as one of the preparatory activities before actual project works can begin. This will hence reduce the anticipated adverse impacts on local traffic.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|------------------------|
| Severity of impact | -3 |
| Spatial scope of impact | -4 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -5 |
| Frequency of impact | -4 |
| Result | -90 Medium-High |

Mitigation:

- Ensure the local roads and bridges to be used by the project are improved before construction works start;
- Ensure that all regulations relating to traffic management are observed and notify the local traffic officials and KTDA of the construction traffic plan and activities;
- Where necessary, traffic management plan should be developed together with alternative arrangements / diversions. The plan should define the construction routes and speed limits; and
- Install adequate and appropriate traffic warning signage and associated road furniture as well as enforcing speed limits for construction vehicles on the project affected roads.

7.3.19 Occupational and General public Safety and Health Hazards

While undertaking construction activities, the workers in the project will be exposed to various health risks including but not limited to the following:

- Operating machineries, equipment and materials that will be used during the construction phase. Some of general ones will include various handheld tools, concrete mixers, cutting/welding machines etc;
- Working in cold waters for long period;
- Extremely dusty, noisy and or vibrating working environments;
- Falling into deep adits/shafts under construction;
- Handling of blasting explosives;
- Confined spaces in tunnels, tunnel support structural failure and poorly ventilated and lit conditions as well as encountering dangerous gases during tunnelling;
- Hot and dangerous chemicals like cement mixtures, paints etc.; and
- Accidents with construction vehicles

Research has shown that respiratory diseases are frequent in tunnel construction workers and this is worsened by cold conditions (Arcangeli *et al*, 2004).

The general public may also be exposed to dangers like falling into uncovered trenches/adits/shafts, drowning in unprotected river banks and accidents involving construction vehicles. Many settlements in the project area are sited along the roads and most locals will be exposed to speeding construction vehicles.

AWSB has incorporated as contract condition, a requirement that the Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Additionally, the proponent has made it a requirement for bidding contractors to include in their bidding documents, provision of:

- A medical clinic with wards (3 each for males and females);
- At least two ambulances;
- First aid huts/stations; and
- Trained first aiders, 1 for every gang.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|------------------------|
| Severity of impact | -5 |
| Spatial scope of impact | -3 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -4 |
| Frequency of impact | -4 |
| Result | -88 Medium-High |

Mitigation:

- Contractor must develop Construction Safety and Health Policy in compliance with OSHA, World Bank and international best practice e.g. IFCs Environmental, Health and Safety Guidelines. The policy should be approved by Environment, Health and Occupation Officer from AWSB and DOSH;
- Include a specific and independent task in the supervision contract concerning H&S supervision and compliance, together with the staff resources to carry this out;
- Establish and enforce a strict code of conduct for all project drivers including outside suppliers delivering materials. The code should focus on safety, especially speed, and loading, especially banning all carriage of staff, workers and passengers except in seats;
- Implement the specified H&S programme throughout the construction period;
- The contractor should establish an emergency response procedure and display on all work areas during construction activities;
- Contractor must secure licenses and adhere to their requirements for handling explosives by the Department of Mines and Geology;
- Construction sites should be adequately barricaded from the general public and conspicuous warnings posted in national and local languages; and
- The contractor should ensure compliance with all standards and legally required health and safety procedures in line with OSHA, 2007, Mining safety rules, explosives act and their associated rules and regulations.

7.3.20 Spread of communicable diseases

During the construction phase there is a risk of spread of communicable diseases such as tuberculosis, diarrhoea, Upper respiratory tract infections and pulmonary infections. Aspects of the physical environment that promote transmission of diseases include: inadequate housing, disposal of wastes and ventilation which are likely to occur during the construction phase of the project.

In addition to the above, most parts of the project area and neighbouring villages do have proper sanitation facilities but require improvement. The baseline survey found that a majority, that is 93.23% of the population in the project area use simple pit latrines. Despite the high number of usage of sanitation facilities, an increase in unplanned for population could trigger a deficiency in toilet facilities. This could aggravate cases of diarrhoea which according to the District Public Health Officers ranks 4th of the most prevalent diseases in Kangema and 8th the most prevalent diseases in Kigumo.

The influx of people could also increase the likelihood of increase in diseases such as typhoid, tuberculosis, diarrhoeal diseases, malaria, respiratory diseases, dysentery and cholera. The project area of influence is already affected by these pandemic diseases.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|-------------------------|
| Severity of impact | -4 |
| Spatial scope of impact | -3 |
| Duration of impact | -2 |
| Frequency of activity / duration of activity | -3 |
| Frequency of impact | -3 |
| Result | -54 Low - Medium |

Recommendations

- The Community Liaison Office should organize for community and workers training programs in conjunction with the Sub-County Public Health Officer. This will facilitate development of more sanitation facilities within the community and also increase usage;
- Covering and / rehabilitation of borrow pits to prevent breeding of mosquitoes that spread malaria;
- Dust proofing of earth roads within the construction site through three (3) times watering a day. This can be done in the Morning, Noon and Afternoon or through powering of gravel.

7.3.21 Growth of unplanned settlements

The influx of immigrant workers will strain local resources especially accommodation and may lead to emergence of unplanned settlements.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|----------------|
| Severity of impact | -2 |
| Spatial scope of impact | -2 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -2 |
| Frequency of impact | -4 |
| Result | -42 Low |

Mitigation:

- As much as feasible, the unskilled labour should be obtained from amongst the locals;
- Liaise with Murang'a county government to control developments in the area and ensure provision of adequate services

7.3.22 Disturbance to neighbouring land owners

Construction activities and construction personnel on site, as well as construction vehicles moving to and from site would cause some disturbance to landowners adjacent to the various sites including destruction of uncompensated for crops and trees. However, the existing low residential densities limit the significance of any impact on surrounding landowners.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|---------------------|
| Severity of impact | -2 |
| Spatial scope of impact | -2 |
| Duration of impact | -1 |
| Frequency of activity / duration of activity | -2 |
| Frequency of impact | -3 |
| Result | -25 Very Low |

Mitigation

- Adjacent landowners must be informed of the commencement of construction activities;
- A Community Liaison Officer (CLO) shall be appointed to be an intermediate between the project team and the surrounding community; and
- No venturing into the surrounding communities by construction workers shall be allowed.

7.3.23 Increased demand on utility supplies and Disruption services

NTC1 implementation will create pressure on existing local utility services including water and electricity supplies. For instance, the estimate construction electricity demands for the various components from 2.5 to 4.9 MVa. Even though water resources may be readily available in the clean rivers in the area, electricity supply may require upgrade on the existing local network to match project demands lest it creates a lot of interruptions including the operations in tea factories and trading centres. Other existing utility services likely to be interrupted by the project construction activities include:

- Community Water pipeline alongside the Irati Bridge;
- Irati Nginda intake for Muranga South W&S Company located downstream the proposed Irati intake works;
- Gacharage tea factory water intake works on Gitaigua stream just before joining Irati near the proposed Irati intake whose disruption may affect factory operations;
- Road bridges near all the proposed intake points, the outfall and Kaanja adit;
- Power supply during project connections to the grid.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|------------------------|
| Severity of impact | -3 |
| Spatial scope of impact | -3 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -5 |
| Frequency of impact | -4 |
| Result | -81 Medium-High |

Mitigation

- Ensure any power demand beyond the existing capacity is installed before construction begins;
- Liaise with relevant utility service providers and roads authorities to minimize any service disruptions;
- Ensure advance notice to all stakeholders including water service providers and KTDA of any planned disruptions

7.3.24 Visual impacts

Portals excavations and tunnelling activities will generate a lot of spoil. It is proposed that these will be stored within the project area at selected points to be acquired from willing land owners. Accumulated spoils will change the current green (dominated by tea bushes) landscape with bare earth-like materials conspicuously visible from any locations across the valleys. Similarly, portal structures at the intakes, adits and outfall will also create conspicuous artificial surfaces on the dominantly green area. However, given the hilly nature of area landscape, the resultant visual impacts will only be noticeable from limited locations directly facing the affected area. The impacts can thus be rated as insignificant with implementation of the proposed mitigations.



Figure 7-2: Example of landscape of proposed spoil site viewed from across the Gikigie river. The green cover will be replaced by freshly cut earth materials

Impact Analysis Matrix

| | |
|--|-------------------------|
| <i>Impact without Mitigation</i> | |
| Severity of impact | -2 |
| Spatial scope of impact | -3 |
| Duration of impact | -3 |
| Frequency of activity / duration of activity | -4 |
| Frequency of impact | -5 |
| Result | -72 Low - Medium |

Mitigation

- Encourage reuse of spoil materials e.g. in roads construction and maintenance, as far a feasible to reduce land area used for spoil storage; and
- Incorporate landscaping at adits and portals to camouflage the introduced concrete surfaces

7.4 Positive Operation Impacts

7.4.1 Improved City water supply

Enhanced water supply to Nairobi City County is the main aim of the project. Nairobi is experiencing a water crisis with the current demand (750,000m³/day) far much outstripping supply (540, 000m³/day). Most Nairobi residents are therefore accustomed to water rationing. The proposed project will therefore ensure improved water provision to Nairobi residents and its satellite towns after full implementation of all its components including the new treatment works and pipelines.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|-----------------------|
| Severity of impact | +5 |
| Spatial scope of impact | +5 |
| Duration of impact | +4 |
| Frequency of activity / duration of activity | +5 |
| Frequency of impact | +5 |
| Result | +140 Very High |

7.4.2 Employment opportunities

During operation phase, the project will offer direct employment to persons who will be in charge of Operation and Maintenance (O&M) of the tunnel. This will likely require expertise that is not currently available with NCW&SC, the final operator of the scheme, hence the required personnel will also benefit from further training. The additional income will uplift the living standards of the beneficiaries, their families and local communities.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|-----------------------|
| Severity of impact | +5 |
| Spatial scope of impact | +5 |
| Duration of impact | +4 |
| Frequency of activity / duration of activity | +4 |
| Frequency of impact | +5 |
| Result | +126 Very High |

AWSB should emphasize the use of local labour in tunnel O&M as far as feasible to enhance benefits for the local population and develop national capacity.

7.4.3 Benefits in Public Health

Increased water supply to the city and its satellite towns will reduce water rationing currently experienced in many parts of the city. This will in turn realise some improvements in public sanitation and hence general public health as more households gain regular access to potable water. On the other hand, a medical clinic and at least two ambulances are proposed under the project within the project area in Kigumo and Kengema sub-counties. These will see increased access to health services by the local communities beyond the project implementation period.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|-----------------|
| Severity of impact | +4 |
| Spatial scope of impact | +4 |
| Duration of impact | +4 |
| Frequency of activity / duration of activity | +4 |
| Frequency of impact | +4 |
| Result | +96 High |

7.4.4 Community support schemes

As part of giving back to the community from where it is drawing its water supplies, AWSB has strategy to address the water needs of the communities living along and downstream of the proposed Northern Collector Tunnel Phase 1. This will complement the efforts of Tana Water Services Board (TWSB) in provision of water to these communities. This will see the Murang'a communities benefit from development of water projects to the tune of KSh. 1.270 billion. The key projects to be developed under this arrangement include:

- Muranga W/S (augmentation) – KSh. 800 Million;
- Gatanga W/S (augmentation) - KSh. 300 Million; and
- Gatanga W/S (augmentation) – KSh. 170 Million.

Impact Analysis Matrix

| <i>Impact without Mitigation</i> | |
|--|-------------------------------|
| Severity of impact | +4 |
| Spatial scope of impact | +3 |
| Duration of impact | +4 |
| Frequency of activity / duration of activity | +4 |
| Frequency of impact | +5 |
| Result | +99 <i>Medium-High</i> |

7.5 Negative Operation Impacts

7.5.1 Hydrological Impacts

River flows are a critical factor for the creation and maintenance of river and floodplain morphology and their associated fauna, flora and ecosystem services. The hydrological impact of the proposed project is twofold; on the source rivers (Irati, Gikigie and Maragua) due to reduced flows, and on receiving rivers/waters (Githika river and Thika dam) due to increased flows. A major consequence of Phase 1 will be a substantial reduction in flow and changes to the natural flow regimes of the donor and receiving rivers.

The hydrological impacts can be divided into three categories:

- Geomorphologic (rates of sedimentation, and channel width, depth, cross-section and profile);
- Water quality (physical and chemical quality); and
- Hydrological (water level and discharge volumes)

(a) Hydrological Impacts of Reduced Flows

Reduced flows will be experienced in Maragua, Gikigie and Irati rivers

(i) Hydrological and geomorphological changes

The diversions from the three Rivers; Maragua, Irati and Gikigie will reduce the river flows after the intake points and the reduction in discharge will alter the width, depths, velocity patterns and shear stresses within the river channels. This will substantially change the natural flow variability, like annual flow magnitudes; mean flows, median flows, low flows, medium, high flows, and increased inter-annual variability. This situation can modify the distribution and availability of in-stream habitats and altered flow regimes have also been linked to invasion of non-native species.

(ii) Temperature changes

Artificially low flows may increase water temperatures by increasing the area of air-water interface per unit volume of water. Increases in water temperature will affect the river fauna and flora in the affected rivers.

(iii) Water quality changes

An artificial reduction in flow reduces dilution of effluent which is returned to increasing the concentration of pollutants already within and newly entering the watercourse. This is however not expected within the current set up as no industries currently release their effluent into the Project Rivers.

(iv) Sediment deposition

Periodic high flows (spates or freshets) are important for maintaining in-stream habitats by flushing fine sediment out. The highest flows also play a role in maintaining channel carrying capacity and structure. Similarly, artificially low flows can result in fine sediment being deposited in the channel. This can clog interstitial spaces in the substrate, thus reducing available habitat

(b) Impacts of Increased Flows (receiving rivers)

The increased flows will be experienced in the Githika River:

(i) Hydrological and Geomorphological impacts

The artificial increase in the River flow will increase the river flows at the and after the tunnel outfall at Githika River and Thika dam. The increased discharge will alter the width, depths, velocity patterns and shear stresses within the river channel. This will substantially change the natural flow variability, like annual flow magnitudes; mean flows, median flows, low flows, medium, and increased inter-annual variability. However no more riparian land will become inundated during high flow because from the design operating principle, the tunnel is designed to close during the high flows, hence no more water will reach the Githika River and the Thika dam. There will be an increase in the wetted perimeter and this may modify the distribution and availability of in-stream habitat.

(ii) Temperature changes

Artificially high flows may reduce water temperatures by reducing the area of air-water interface per unit volume of water. Reduced water temperature will affect the river fauna and flora in the affected rivers in various ways.

(iii) Water quality changes

An artificial increase in flow increases dilution of effluent which in turn reduces the concentration of pollutants already within and any new ones entering the watercourse.

In Thika reservoir, water spill will occur during wet and average years due to overwhelming inflows from increased flows in the Thika River that usually feeds the dam and combined inflow from the northern collector rivers.

From hydrological assessment, it was established that since the project abstraction will be based on flood flow and not Normal River flows, there will be minimal effect on the normal flows.

Impact Analysis Matrix

| | |
|--|------------------------|
| <i>Impact without Mitigation</i> | |
| Severity of impact | -3 |
| Spatial scope of impact | -4 |
| Duration of impact | -4 |
| Frequency of activity / duration of activity | -5 |
| Frequency of impact | -4 |
| Result | -99 Medium-High |

Mitigation Measures

- For the increased inflow into Thika reservoir, ensure that the new off take is continuously operational at optimal levels to evacuate the increased volumes;
- For possible increased inundation of the riverine areas, installation of a gauging station after outfall, will help monitor the water levels changes, so as appropriate measures can be taken;
- The Aberdare catchment conservation efforts should be enhanced to reduce possible sedimentation in to northern collector rivers, which may end up in the Thika reservoir, causing sedimentation of the reservoir;
- Conduct regular water sampling and laboratory analysis to monitor the water quality variations;
- Encourage local communities to plant indigenous trees on the riparian lands to ensure water temperatures are not increased;

- Deliberate, compensation release of adequate amount of water downstream to mitigate alteration of the river ecosystem;
- WRMA should conduct routine In-stream Flow Release compliance audit/monitoring once operation commences and use gathered information to guide management interventions; and
- The design should adopt a variable abstraction of water based on seasonality of flows.

7.5.2 Impacts on Aquatic Fauna

(a) Impacts of low water discharge

Water abstraction from the three rivers will reduce the flow speed, particularly in the dry season. This will partly lead to increased water temperatures and decreased dissolved oxygen which will affect aquatic life. Low water flow may cause spawning areas to dry or access may be reduced. Loss of spawning areas not only limits space required for egg deposition but also reduces spawning efficiency causing stress due to increased density of spawners.

Mitigation

- Ensure the adequate release of water during the dry season.

(b) Changes in food availability

Fish food organisms (macro-invertebrates) including mayflies, stone flies, caddis flies as documented in the present study will be highly affected by reduced flow rates and new species will invade areas with a slow current for example the riffle species such as the blackfly *Simulium* sp, riffle beetles *Elmidae* spp., flatheaded mayfly *Afronurus harrisonii* etc.

Mitigation

- Ensure the minimum ecological flow required for all affected rivers is observed

(c) Changes in water velocity

Riverine fishes adapted to fast current (riffles) such as the mountain catfish *Amphilius uranoscopus* and Dembea stone lapper *Garra dembensis* may be lost. Some of these fish take advantage of the high speed flows over riffles which drift invertebrates which form part of their diet.

Any insects adapted to clinging on high water currents may also be lost or forced to swim during periods of stagnant or low speeds.

Mitigation Measures

- Ensure the minimum ecological flow required for the other rivers is observed

(d) Interference with fish movement/passage

Weirs will create permanent barriers to natural migratory paths to fish such as *Anguilla bengalensis*, *Oncorhynchus mykiss*, *Salmo trutta* etc. However, the project design has incorporated fish passes which have been assessed by ecologist as adequate for the existing species.

Recommendation

Fish pass should be tested during the first few years of operation to confirm it meets flow velocity requirements and allows safe passage for all documented species.

(e) Overall impact

(i) Setting the minimum environmental flow requirements

To evaluate the overall ecological impact of the project operation on the three rivers, minimum ecological flow requirements should be established. Studies on fish life and the related habitat parameters (habitat requirements) have made it possible to determine criteria for habitat requirements for use in low flow. For instance, Neuman and Newcombe (1977) have detailed criterion of measurable characteristics of fish habitat that will influence fish (in particular salmonids) during low flow. In addition, the Authors assess any potential effects of low flow on the life span of the fish including spawning and maturity stages.

Habitat requirements for both aquatic fauna encountered during the project ecological survey and the two species (*Oncorhynchus mykiss* (Rainbow trout) and *Salmo trutta* (Brown trout)) whose presence was indicated by secondary literature and local knowledge were considered in this assessment.

Thompson, (1972); Bell (1986) and Jowett *et al.* (2008) reported that the rainbow trout has higher flow requirements (e.g. Minimum Depth=0.18m, Minimum velocity=0.3-3 m/s) than other native fish. Given the angling use of these rivers, the habitat for rainbow trout was adopted for use to set the minimum ecological flow requirements to retain adequate water depths and velocities in streams so that provision of habitat for rainbow trout will also provide habitat for native shallow water flow sensitive species such as the mountainous catfish *Amphilius uranoscopus* that occur in riffles with shallow depths of less than 0.18cm. The rainbow trout is an introduced species in Kenya (1910) which has become naturalized (Hickley *et al.*, 2008) and has been widely studied worldwide and its flow requirements were long established (Thompson, 1972).

Eels are known to be relatively flexible and can exist in a wide range of stream conditions. The use of the trout to set minimum flows is an example of a Regional method for in-stream flow assessment to set minimum flow which would apply just as has been used in the areas where it was introduced from rivers that have similar hydrological conditions (Jowett *et al.*, 2008). Small fish have lower swimming speed and prefer low velocities and depth than large fish. Adult salmonids usually move upstream or into tributaries to spawn and the juveniles rear in these upstream areas and the adults move back downstream in deeper waters. The effect of an abstraction is usually greatest immediately below the abstraction site, but diminishes as the river flow is supplemented by contributions from tributaries and the proportion change in flow reduces.

(ii) Computation of the threshold Environmental flow based on the Rainbow trout fish species

The depth requirement for the trout was converted into discharge at the gauging stations; using River flow rating curves for the three Rivers. The results were then transposed to the intake sites using the area proportioning method to get trout requirements on the project rivers as presented in Table 7-4.

Comparison of the rainbow trout water requirements and the flows recommended for the design of weirs is shown in Table 7-5.

Table 7-4: Computed flow requirements for the rainbow trout fish species

| River | Station | Effective area (km ²) | Intake area (km ²) | Ratio | Depth (m) | Q m ³ /sec | Q m ³ /sec (Intake) |
|---------|---------|------------------------------------|--------------------------------|-------|------------|-----------------------|--------------------------------|
| Maragua | 4BE01 | 414 | 36.4 | 0.09 | 0.18 | 0.259 | 0.259 |
| | 4BE09 | 43.0 | 36.4 | 0.85 | 0.18 | 0.126 | 0.126 |
| Gikigie | 4BE08 | 15.0 | 14.4 | 0.96 | 0.18 | 0.239 | 0.133 |
| Irati | 4BE03 | 102 | 35.2 | 0.35 | 0.18 | 0.989 | 0.989 |

Table 7-5: Compensation flows recommended for the design of the weirs vs the rainbow trout fish requirements

| River | Lowest naturalised mean monthly flow (m ³ /sec) | Threshold at intake | Q m ³ /sec | Rainbow trout needs (m ³ /sec) |
|---------|--|---------------------|-----------------------|---|
| Maragua | 1.00 | Q95 | 0.481 | 0.259 |
| Gikigie | 0.18 | Q95 | 0.10 | 0.133 |
| Irati | 0.67 | 1.4Q95 | 0.645 | 0.989 |
| | | Q95 | 0.461 | |

From Table 7-5 it is evident that, the proposed flow release for Maragua intake (0.481m³/sec) meets the calculated minimum trout fish requirement (0.259m³/sec). However, for both Irati and Gikigie rivers, the proposed flow releases are lower than the calculated minimum rainbow trout fish requirements.

In order to meet the calculated rainbow trout flow requirements, the design flows at Gikigie and Irati intakes would require upward revisions as shown in table below.

Table 7-6: Minimum design flows required to meet calculated habitat needs

| River | Threshold at intake | Q m ³ /sec | Rainbow trout needs (m ³ /sec) |
|---------|---------------------|-----------------------|--|
| Gikigie | 1.32Q95 | 0.133 | 0.133 |
| Irati | 2.15Q95 | 0.991 | 0.989 |

However, it is notable that the calculated minimum requirements for rainbow trout from this study are higher than the naturalised mean monthly flow e.g. for Irati river and cannot be conclusively used to set the minimum ecological flow requirements. This could also mean that the rainbow trouts species is not distributed throughout all the rivers in all seasons hence the need to ensure that any migration is not impeded for continuous habitats connectivity. The study therefore recommends the implementation of the compensation flow as designed but with strict enforcement of the proposed weir operating principles.

According to FAO, 1995, large changes to low flows ($\pm 20\%$) will alter micro-habitats. If water withdrawals were to cause consistent, drought-like conditions, fish populations could be affected all year round and it is uncertain how well the aquatic community in the project area would recover. Since the proposed project abstractions will be based on flood flow and not normal flows, there will be no effect at all on the normal flows. The anticipated reduced frequency of low-flows will be associated with some habitat loss for riverine fishes during periods of low-flows with Irati likely to be the most affected. However, no permanent riverine habitat loss is anticipated and there is no species of conservation significance that will be impacted.

Impact Analysis Matrix

| Impact without Mitigation | |
|--|------------------------|
| Severity of impact | -4 |
| Spatial scope of impact | -3 |
| Duration of impact | -4 |
| Frequency of activity / duration of activity | -4 |
| Frequency of impact | -4 |
| Result | -88 Medium-High |

Mitigation

- Ensure the proposed abstraction weirs operation principles are met throughout the operation period for all rivers via continuous monitoring. Reduced abstractions during low-flow seasons achieved by this will help sustain riverine habitats during these periods;
- Construct fish passes as planned and ensure they are regularly maintained to allow safe passage for all identified migratory species;
- Ensure demarcation and protection of riparian reserves of the affected rivers. This will offer favourable cover and temperatures for the rainbow trout;
- Undertake wet season survey and subsequent annual aquatic fauna surveys for both wet and dry seasons to monitor trends and inform any further management interventions; and
- AWSB in liaison with other agencies must sustain conservation efforts for Aberdare Forest Reserve.

7.5.3 Impacts of receding water depth on Flora

Reduced water levels anticipated downstream the proposed intake works on rivers Maragua, Gikigie and Irati are likely to have the following impacts on riparian vegetation:

- Rooted plants will grow in the riverbed due to the decrease in water volume for example the *Ficus sp*, *Cycamore spp.*, *Psidium spp.*, *Maesa lanceolata*, etc.; and
- Changes to riverine flora may occur.

The survival of high water specific species may be affected by alteration of water levels and flow but self-mitigating adaptations may maintain their existence, though in predictable low populations. In a speculative evaluation of water diversion consequences, survival measures may include shift in habitats towards shrinking banks and the potentially shallow or dry river beds. Consequential succession effects will also affect post bank vegetation. There will be a possibility of development of new species associations, composition or colonization of more adaptive plants currently in the sites or even by new species to the sites, especially from farmlands. Among the species whose populations are expected to diminish include; *Alternanthera sessilis*, *Colocasia esculenta*, *Begonia meyeri-johannis*, *Sphaeranthus suaveolens*, *Spermacoce princeae*, *Hydrocotyle sibthorpioides*, *Centella asiatica*, *Embelia schimperii* and *Kyllinga comosipes*. Some of the species that has even a higher degree of river affinity and will have reduced chances of survival include; *Cyperus schimperianus*, *Fimbristylis complanata*, *Ludwigia abyssinica*, *Ludwigia stenorrhapha*, *Echinochloa colona*, *Mikania chenopodiifolia*, *Breonadia microcephala* and *Polygonum setosulum*. Extreme low river flow may therefore have the potential to affect seed dispersal and hence future distribution and density of certain plant species. However, none of these species are listed as endangered under the Wildlife Conservation and Management Act, 2013 and the IUCN red data list and considering that occasional rains will keep river levels near normal within the year, worrying vegetation disruption may not be expected.

Impact Analysis Matrix

| | |
|--|------------------------|
| Impact without Mitigation | |
| Severity of impact | -4 |
| Spatial scope of impact | -3 |
| Duration of impact | -4 |
| Frequency of activity / duration of activity | -4 |
| Frequency of impact | -5 |
| Result | -99 Medium-High |

Mitigation

- Ensure the requisite compensation flow is available downstream at all the time;
- Support local communities to plant indigenous trees along the rivers and not the exotic *Eucalyptus* trees as is the present case. Awareness on the same should be enhanced;
- The riparian extent of the project affected rivers should be defined by WRMA (based on the 6-30m rule from river banks) and be enforced by WRMA and NEMA among other stakeholders to prevent people farming up to the river banks to reduce siltation; and
- Undertake continuous ecological monitoring of hydrophytes and high water specific species to track and mitigate any emerging impacts of the project on the plants.

7.5.4 Community Safety and Health Concerns

Safety concerns during operation are at two levels, for the tunnel O&M and due to increased supply to the existing Thika dam

During the operation phase, O&M workers will be exposed to various risks from working/servicing the underground tunnel. Some of these risks include:

- Working in confined spaces with poor lighting and ventilation;
- Drowning in tunnel water;
- Encountering toxic gases like hydrogen sulphide and explosive gases;
- tunnel failure; and
- Communication/equipment failure while underground.

Additionally, the increased water supply to Thika dam will increase its volumes with increased risks to safety nearby community in case of any operational failure. This was a concern identified by many public members contacted during the consultation exercise. However, the dam has the capacity to handle the additional volumes which will also be evacuated directly to the new treatment works in Kigoro.

Impact Analysis Matrix

| | |
|--|-----------------------|
| Impact without Mitigation | |
| Severity of impact | -5 |
| Spatial scope of impact | -1 |
| Duration of impact | -4 |
| Frequency of activity / duration of activity | -3 |
| Frequency of impact | -3 |
| Result | -60 Low-Medium |

Mitigation:

- AWSB should establish and implement NCT1 tunnel specific comprehensive O&M Safety and Health Management Plan within which it ensures that:
 - All potential hazards are identified and appropriate mitigations put in place;
 - Pre-entry activities are defined including the method statements, hazards assessment, incident action plan, communication plan, personnel

- accountability plan, personal protective equipment list, and atmospheric monitoring equipment list;
- Appropriate PPE for O&M staff are available throughout;
- Requisite instrumentation and available and operable;
- AWSB in liaison with the Ministry of Health should ensure the clinic and ambulances to be built/acquired under the project remain operational in the project area throughout the operational life; and
- AWSB should review and update the existing Safety and Emergency Plan for Thika dam.

7.5.5 Seismic risks

Apart from landslides which are known to be common in the area, no other records on seismic risks of the area are available. From review of project geotechnical report, the nearest faultlines, Sattima fault line, is about 15 km to the west of the tunnel alignment. Landslide and earth movements may cause operational failures from blocking or causing cracks in the tunnel. In the final design report, modelling of likely ground movements was done using finite element analysis for sections of the tunnel through soft rocks and residual soils considered to be of relatively low strength of the ground compared to other sections of the alignment. The modeling was to inform the design of support during construction and consider the effectiveness of primary support proposed. The maximum deformation anticipated (considering excavated tunnel with primary support) at caverns from the modeling was evaluated as approximately 5mm for Kaanja and 10mm for Gikigie

The Project has been designed and will be constructed and operated in accordance with best international standards for protection against seismic activity. As a result, seismic risks should be as low as technically and financially feasible. Further, regular monitoring will be carried out through appropriate instrumentation in the tunnel and tunnel inspection carried out soon after any seismic event.

7.5.6 Tunnel leaks

Leaks may occur along the tunnel during the operation phase due to cracks in the concrete lined system leading to water losses.

Mitigation:

- Monitoring of volumes at intakes and discharge at outfall to allow loss detection; and
- Ensure regular inspection and maintenance of the tunnel.

7.6 Cumulative Impacts

Cumulative impacts relate to the aggregate of past, present and future actions, and may also arise from additional factors or developments not directly related to the upstream diversion of water via the Northern Collector tunnel to Thika Reservoir. Effects from different activities may also interact to cause additional effects not initially apparent when considering the individual developments or changes, and there may also be synergistic interaction between different factors. The following cumulative impacts are anticipated from implementation of NCT1.

7.6.1 Cumulative Impacts on downstream hydrology

The Gikigie River joins the Maragua River approximately 4.8km below the proposed Gikigie Intake Weir. Further downstream, the Irati subsequently merges with the Maragua River after flowing for 29km. Below these junctions, impacts from reduced flows released at the Intake Weirs will be related to the combined releases from each weir. Records from the river gauge at Maragua (RGS: 4B01) represent flows below the junction of all the three rivers and allows an assessment of the changes in flow at this point to be estimated. RGS: 4BE01 lies approximately 22 km along the course of the Maragua River below the junction with the Irati. Flows at this point include flows from a larger catchment that includes additional tributaries originating from below the Aberdare Forest boundary. However, the Aberdare Forest catchments provide important dry season flow.

The cumulative impacts at Maragua 4BE01 are expected to include the following:

- Reduced flows as a result of diversion of a majority of the flows originating from the Aberdares at Irati, Gikigie and Maragua intakes to the Northern Collector, resulting in:
 - Reduction in the flow reaching Masinga Reservoir and therefore a reduced flow available for hydroelectric power generation;
 - Some short periods or single days with potentially zero flow or near-zero flow. These periods will normally be preceded and/or followed by further periods with extreme low flow;
 - Less flow available for use in existing and future domestic and agricultural activities (e.g. irrigation) in downstream areas.

Potential factors that may ultimately interact with impacts from changed downstream flows on the Irati and Maragua Rivers include the requirements for increased food resources for an increased population in Nairobi, some of which may require increased use of irrigation. Siltation of Masinga reservoir is also a factor that is likely to interact with the changes in flow. Reduction of reservoir capacity by 30% by 2050 due to siltation is considered likely.

Potential factors also include the longer term impacts of climate change as well as the potential changes that are likely to be brought on by "Peak Oil" and the inevitable increase in international oil prices. The increase in international oil price, coupled with the reduced availability of oil, will impact on consumers and is likely to result in less daily movement between Nairobi and adjacent areas, and a resulting shift in demand for water from Nairobi to the adjacent areas. Increased oil prices may also put increased pressure for development of hydropower, including mini-hydro.

7.6.2 Changes in flows in Maragua River at RGS: 4BE01 and Hydropower production

There are three small hydropower generation stations along the Maragua river basin. All of the stations are at the downstream of the Maragua confluence with Gikigie and Irati rivers and include Wanjii, Mesco and Tana.

From hydrological assessment, the established Natural flows at Maragua RGS: 4BE01 are illustrated by the flow patterns shown in Figure 7-3. The differences between the average

monthly natural and modified flows with release of reserve Flows based on Q95 are shown by Figure 7-5.

The possibility of upstream abstraction resulting in short periods, or single days with zero flow downstream can be illustrated by recorded natural flows during 1991 and estimates of modified flows. For example, in 1991, a period of 27 days with extreme low flows under natural flows (see Figure 7-4) results in, following upstream abstraction and release of Q95 based Reserve Flows, a period of 8 days with zero flow and a further 13 days with flows of less than 0.8 m³/sec. Modelling changes in flow using the 1973-2010 time series results in 0.2% of daily flows equal to zero (in 15 separate occasions), and 0.75% of daily flows of less than 1.0 m³/sec. The extreme low flow threshold for natural flows at 4BE1 is 2.2 m³/sec. These zero flow periods can be mitigated by the release of greater flow volumes from the Northern Collector intake sites at those times when these zero flows or very low downstream flows are considered likely.

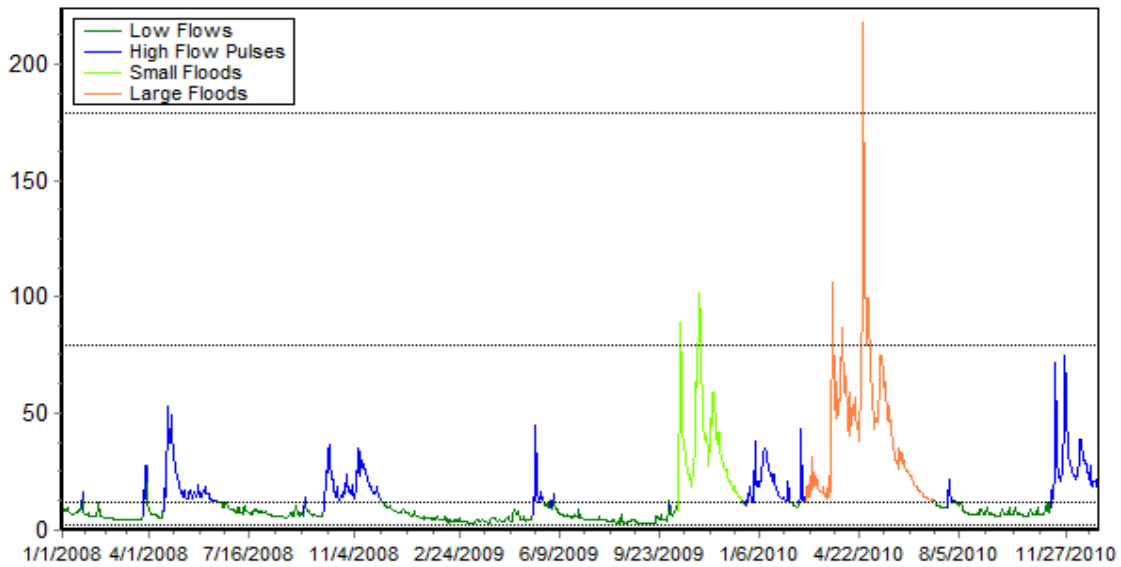


Figure 7-3: Flows at Maragua RGS: 4BE1, 2008-2010 (m³/sec), illustrating characteristic seasonal patterns of flow with occasional periods of small floods and large floods (extreme low flows were not recorded during this period).

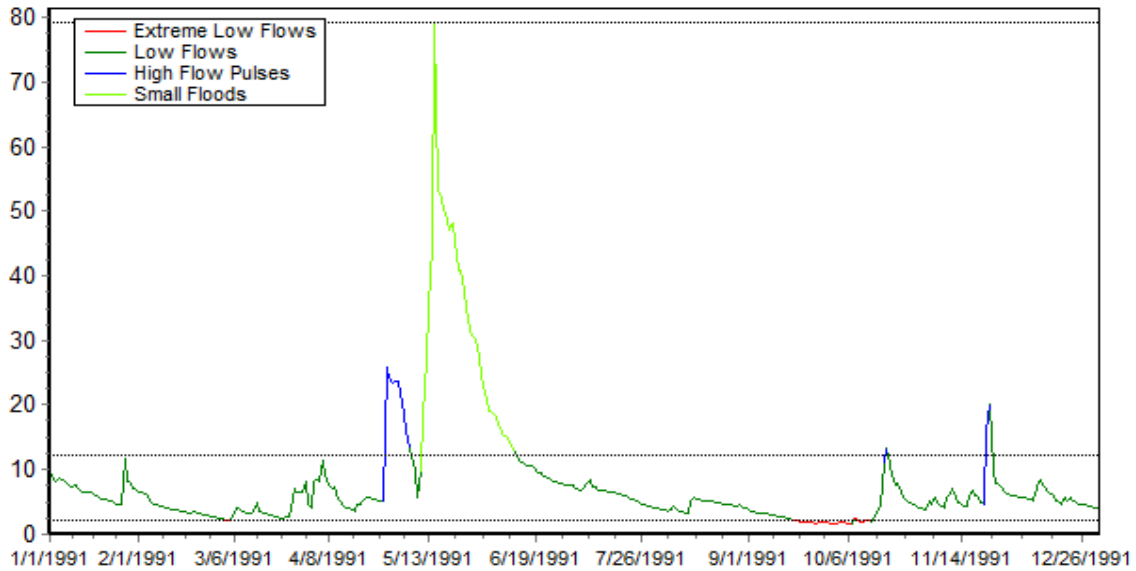


Figure 7-4: Natural Flows at Maragua RGS: 4BE1 during 1991 (m³/sec), illustrating a period with extreme low flow.

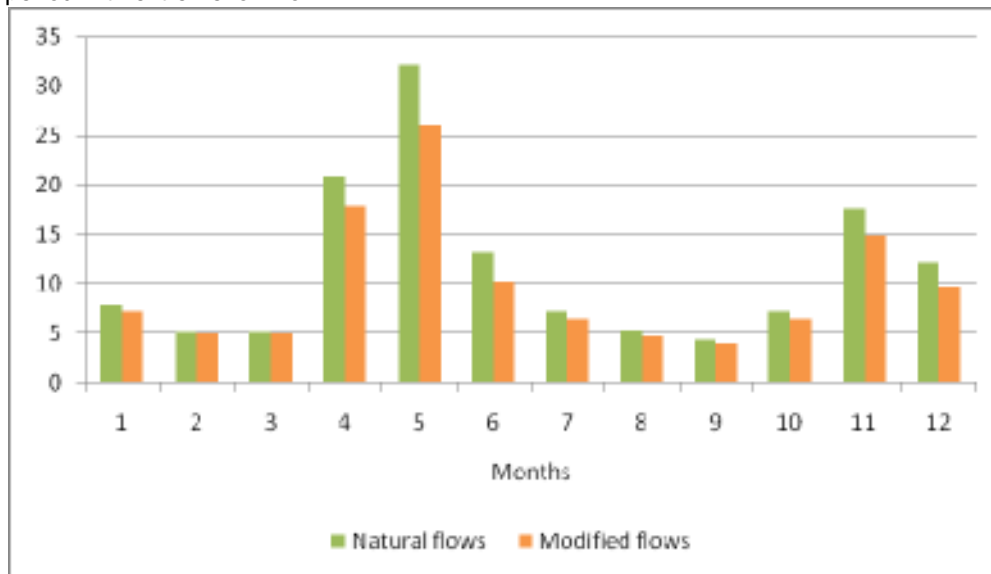


Figure 7-5: Flows at Maragua RGS: 4BE1 (1973-2013). Differences between the average monthly Natural flows and Modified flows with Reserve Flows based on Q95 released at Northern Collector intakes (Irati, Gikigie and Maragua)

The inflow into Masinga dam comes from the Tana River and Thika River and only the component from Tana may be affected. Mean annual flow reaching Masinga Reservoir from Maragua River can be expected to be reduced by the diversion of upstream flows into the Northern Collector Tunnel Phase 1. Available published information on average monthly flows into Masinga Reservoir are indicated in Figure 7-4 (1995-1997). Taking the daily 1995-1997 flow data from Maragua 4BE1, modified to include upstream abstraction for the Northern Collector with release of Reserve Flows based on Q95, results in an overall annual average reduction of inflow of 2.32% for inflow to Masinga Reservoir, or a reduction in volume of 2.72 m³/s relative to average inflow of 125.51 m³/s (1995-1997). Flows in the Tana downstream of Masinga Reservoir can also expect to be reduced, but the overall effect will be negligible.

Table 7-7: Average flows into Masinga Reservoir (m³/sec), and potential changes following diversion of water to the Northern Collector Phase 1

| | Masinga 1995 | Masinga 1996 | Masinga 1997 | Masinga Average 1995-97 | Maragua 4BE1 natural | Maragua 4BE1 modified | Masinga with modified 4BE1 | % change |
|-----------|-----------------|-----------------|-----------------|-------------------------------|----------------------------|-----------------------------|-------------------------------------|-------------|
| January | | 103.3 | 21.83 | 62.57 | 4.42 | 3.17 | 61.32 | 2.00% |
| February | 10.05 | 86.71 | 13.59 | 36.78 | 5.06 | 4.22 | 35.94 | 2.28% |
| March | 49.32 | 57.35 | 16.08 | 40.92 | 5.08 | 4.06 | 39.9 | 2.49% |
| April | 679 | 36.47 | 169 | 294.82 | 14.53 | 11.29 | 291.58 | 1.10% |
| May | 289.8 | 70.27 | 363.9 | 241.32 | 28.46 | 22.93 | 235.79 | 2.29% |
| June | 253.7 | 119.7 | 287 | 220.13 | 12.68 | 8.82 | 216.27 | 1.75% |
| July | 170.8 | 122.8 | 187.5 | 160.37 | 7.87 | 5.52 | 158.02 | 1.47% |
| August | 99.25 | 82.22 | 83.38 | 88.28 | 6.04 | 4.21 | 86.45 | 2.07% |
| September | 61.01 | 41.61 | 26.59 | 43.07 | 4.86 | 3.60 | 41.81 | 2.93% |
| October | 39.06 | 15.39 | 175.9 | 76.78 | 14.35 | 11.63 | 74.81 | 3.54% |
| November | 26.77 | 25.24 | 255.7 | 102.57 | 37.74 | 33.02 | 97.85 | 4.60% |
| December | 86.91 | 27.64 | 300.9 | 138.48 | 16.48 | 12.45 | 134.45 | 2.91% |
| Average | 152.74 | 69.19 | 145.50 | 125.51 | 13.13 | 10.41 | 122.79 | 2.32% |

Source: van Loon, A. and Droogers, P. (2006). *Water Evaluation and Planning System, Kitui - Kenya. WatManSup project. WatManSup Research Report No 2.*

In areas adjacent to the Northern Collector intakes agricultural activities are predominantly tea plantation. The small areas under food crops are for subsistence farming are not for sale to Nairobi. At lower elevations below the tea zone, the predominant agriculture is commercial coffee. The agricultural potential in Muranga District generally decreases from northwest to southeast, mainly because of decreasing rainfall and soil fertility. In areas with less rainfall, and with a reduced proportion of commercial tea and coffee, an increasing demand for food crops required by the increasing population of Nairobi is likely to lead to an increased demand for irrigation. For example, in July 2010, it was reported that farmers in Muranga District would benefit from KSh50 million to help them invest in irrigation schemes (Daily Nation, 10 July 2010) and that 17 schemes would use sprinkler, hose, and drip methods of irrigation. With an increase in the local population in areas downstream of the Northern Collector intakes, coupled with an increase in demand for food from a greater population in Nairobi, it is considered likely that there will be increased pressure for use of available resources for irrigation in suitable sites within relatively easy transport distance from Nairobi.

With an increase in the local population in the Muranga area, and an increase in demand for food from greater populations in Nairobi and satellite towns, it is considered likely that there will be increased pressure for use of available resources for irrigation and improved soil water management. However, the estimated decrease in flow at Maragua RGS: 4BE1 does indicate that the overall impact of abstraction for the Northern Collector is relatively small.

The National Water Resources Management Strategy acknowledges the issue of agricultural requirements for water:

Since the agricultural sector accounts for a large proportion of water use in Kenya, introduction of water demand management in this sector is imperative. More efficient irrigation approaches and technologies also need to be adopted. These include:

- i. Assessing the irrigation potential of soils in terms of water loss. This includes determining soil texture, moisture retention properties and the slope and then choosing the more water efficient soils
- ii. Identifying the suitable water saving technology and the efficient production level.'

This will, however, require funding to promote appropriate technologies and enable their wider adoption and use. It is suggested that part of the mitigation of impacts caused by the upstream abstraction of water in the Irati, Gikigie and Maragua Rivers should include funding to assist with the adoption of appropriate technologies.

There is hence need for assessment of the abstractions by downstream water users (both licensed and unlicensed) on a regular basis, including monthly or seasonal abstraction requirements. Based on the assessment of downstream water use requirements, the provision of Reserve Flows can be adjusted to ensure adequate provision of water resources for all downstream users, whilst at the same time maintaining adequate environmental flows.

7.6.3 Increased pressure on city drainage and sewer systems

Completion of the tunnel works and the associated new pipelines for raw water (Thika dam to Kigoro treatment works) treated water (Kigoro Treatment Works to Kabete Reservoir) will eventually result in increased water supplies to the city. This will directly increase waste water generation (it is estimated that 75% of supplied water comes out as waste). Without equivalent improvement of the existing sewer networks and waste water treatment works, this will lead to increased sewer bursts and release of improperly treated waste waters into the receiving rivers of the Athi river basin. This will not only adversely impact on the ecology of the rivers but also deny their downstream users (mainly in arid and semi arid lands) access to good quality water.

Given the arid and semi-arid nature of downstream areas on Athi River, the impacts on rural domestic water users and on irrigated agriculture (both existing and planned) that depend on direct abstraction from Athi River may be significant.

Recommendation

- Ensure timely improvement on existing trunk sewer networks and waste water treatment works in the city of Nairobi and where necessary, development of new ones to manage anticipated increased waste volumes; and
- AWSB should continuously monitor waste water volumes and qualities into and out of the existing waste treatment plants. Such monitoring should also incorporate incedeces trunk sewewrs bursts. Whenever waste waters qualities from the treatment works exceed the thresholds provided in water quality regulations, 2006, appropriate interventions must be initiated on time.

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 Introduction

This chapter presents Environmental and Social Management (ESMP) Plan prepared to show how site specific concerns and mitigation measures are addressed through the engineering, procurement, construction and operation phases of the NCT1 project. The ESMP provides a link between the impacts of project activities and the mitigation measures and responsibilities proposed to minimize these impacts and enhance the positive impacts.

At completion of construction, ownership of the project will be transferred to AWSB who will be responsible to implement environmental management measures associated with operation of the irrigation project.

8.2 Responsibilities of the ESMP

In order to ensure sound development and effective implementation of the ESMP, it is necessary to identify and define the responsibilities and authority of the various persons and organisations that will be involved in the project. Entities that should be involved in the implementation of this ESMP include but are not limited to the following:

- AWB;
- NCW&SC;
- Contractor (s);
- Ministry of Environment, Water and Natural; resources;
- NEMA;
- WRMA;
- Directorate of Occupational Safety and Health;
- Department of Mines and Geology;
- KFS and KWS;
- County government of Murang'a; and
- Local administration.

(a) AWSB / Project Implementation Unit (PIU)

The project implementing agency is AWSB under the Ministry of Environment, Water and Natural Resources. AWSB has set up a Project Implementation Unit (PIU), with a Technical Manager.

AWSB should co-ordinate all aspects of the environment during project implementation and operations (with involvement of NCWSC). This should include following the construction to monitor, review and verify the implementation of the project's ESMP.

(b) Project Contractor (s)

A project contractor will be appointed by AWSB. The contractor must be required to comply with the requirements of the ESIA, the ESMP within this report, any ESIA licences conditions as may be issued with NEMA as well as all relevant legislations.

(c) Ministry of Environment, Water and Natural Resources

All key government environmental and water management and conservation agencies are under the Ministry of Environment, Water and Natural Resources. The ministry is responsible for overall policy direction and is hence better placed to ensure coordination of the said agencies for the conservation and management of the available natural resources within the Aberdare water tower and ensure that a clean environment is sustained throughout the project life.

(d) Water Resources Management Authority (WRMA)

WRMA's regional office in Nyeri and the sub regional office in Murang'a will be involved in the project through its issuance of project water rights and regulations of water abstraction, study for water resources development and coordination of water use within the Upper Tana catchment area.

(e) NEMA

The responsibility of the National Environment Management Authority (NEMA) is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of government in the implementation of all policies relating to the environment.

Apart from the national office in Nairobi, NEMA has local offices in the project area at Murang'a town through which environmental supervision of the project will be conducted.

(f) Directorate of Occupational Safety and Health

Directorate of Occupational Safety and Health (DOSHS) will be responsible for registering the project site as a work station and subsequent enforcement of relevant provisions in occupational safety and health in line with occupational safety and Health Act, 2007.

(g) Department of Mines and Geology

Licensing of any explosives and ensuring safe handling and use

(h) KFS and KWS

Conservation and management of wild fauna and protected forest within the Aberdare water tower

(i) County Government of Murang'a

Murang'a County government is responsible for various environment and public health management issues as iterated in section 2.5.11 and should be incorporated to help enforcement of proposed mitigation and monitoring activities within the project.

In addition, the county government is better placed in dissemination of project information to the local levels through the members of county assembly and ward administrators. Continuous liaison between AWSB and the county government is thus recommended.

(j) The Local Administration

The relevant local administrators should be called upon where necessary during project implementation to provide the necessary advisory services and support to the project implementers.

8.3 Environmental and Social Management

An Environmental and Social Management Plan has been prepared to identify and sequence environmental activities that are needed in order to complete a required construction process.

Prior to commencement the Contractor will be required to prepare own Environmental and Social Management Plan that is in line with the project ESIA and also meets all ESIA license conditions.

8.3.1 Method statements

Method statements would be completed on behalf of the Main Contractor or Sub Contractor by an Occupational Safety and Health Officer and qualified Environmentalist or other appropriate experienced personnel, in consultation with AWSB environmental staff and, where necessary, environmental consultants. Their production would include a review of the environmental and safety and health risks and commitments, as identified in the ESMP and risk assessment, so that appropriate control measures are developed and included within the construction process.

Method statements would be reviewed by PIU, the Main or Sub Contractor's appointed environmental manager and, where necessary, by an appropriate environmental specialist. Where necessary, all method statements would be submitted to the enforcement agencies as appropriate. Method statements would contain as a minimum:

- Location of the activity and access/egress arrangements;
- Works to be undertaken and methods of construction;
- Equipment including any machinery and materials to be used;
- Labour and supervision requirements;
- Safety ,Health and environmental considerations; and
- Any permit or consent requirements including registration of the work place and approval of deployed equipment where required e.g. of cranes.

8.3.2 Control of construction processes

(a) Supervision of construction activities

All construction activities including those carried out by subcontractors and suppliers would be supervised, or regularly checked through the completion of site inspections by the Contractors Environmental Manager, to ensure that requirements identified in risk assessments or method statements have been implemented. The frequency and extent of this supervision would vary according to the degree of competence displayed by the workforce and the level of risk to the environment.

Environmental deliverables required by the CEMP would be subject to regular independent supervision by either the Environmental Manager or the relevant environmental specialists. These inspections would be used to confirm that:

- Construction works are progressing in accordance with the agreed method statements';
- Agreed protection or mitigation measures are in place, prior to or during the implementation of construction activities;
- Construction works have been completed in accordance with the design and commitments made during the statutory approval process.

(b) Environmental inspection and reporting

The Contractors Environmental Manager would carry out an assessment of the project's environmental performance, based upon the reports from the environmental management representatives during the period, reports from the environmental specialists and from his own site inspections. This would be carried out at a frequency at no greater than monthly intervals but could be held more regularly depending on the nature of the construction activity. An assessment of the performance over the month would be made and quantified. A monthly report detailing performance for the period would be provided to the AWSB and would include a summary of environmental inspections completed, audits undertaken, complaints and incidents.

The monthly environmental report would:

- Consider past performance from inspections, audit reports and monitoring data;
- Plan actions required to mitigate forthcoming risks; and
- Disseminate best practice.

8.3.3 Environmental and social due diligence during construction

During the construction phase, environmental due diligence will be incorporated into the Project implementation mainly to:

- Control the residual risk of accidental environmental damage; and
- Prevent the negative environmental impacts during construction.

The contractor and supervising engineer will have the primary responsibility for the due diligence. The supervising Engineer **MUST** be required to include environmental considerations in the monthly progress reports and indicate progress in the implementation of mitigation measures as outlined in the ESMP.

The Construction risks to be monitored will include, but not be limited to the following issues:

- Handling of any hazardous materials including hydrocarbons as part of construction activities;
- Movement of machinery;
- Management of borrow and spoil areas including soil erosion;
- Sedimentation of watercourses;
- Collection and disposal of wastes;
- Management of pollution incidents;
- Safety and health management at construction sites; and
- Addressing local community concerns on the project implementation activities.

The Table 8-1 and 8-2 give a summary of the Environmental and Social Management Plan during Construction and operation phases of the project.

8.3.4 Construction Environmental and Social Management Plan

Table 8-1: Construction Environmental and Social Management Plan

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|---|---|---|------------------------------|---------------------|---------------------------|
| Construction Phase | | | | | |
| Construction of weirs, adits, portals and outfall; Acquisition of easement above tunnel alignment | Loss of land and resettlement; and Economic displacement | <ul style="list-style-type: none"> Implement RAP before commencement of the construction works; Plan construction activities to take place during off farming seasons to reduce impacts on crops; and Ensure advance communication to farmers whose farms are likely to be affected allowing time for harvesting of any seasonal crops before the works commence. | AWSB | Before construction | In line with RAP report |
| Tunnel construction activities including boring and blasting of rocks | increased risks of landslides and other Geological/ seismic hazards | <ul style="list-style-type: none"> Implement Geotechnical monitoring through Excavation Performance Review (EPR) system to continuously monitor the Geotechnical stability during the construction phase using appropriate instrumentation; and Formulate an emergency communication plan for alerting the local community where the need arises | Contractor and AWSB | Construction | No additional cost to BOQ |
| Earthworks and transportation activities | Soil erosion and sediment generation | <ul style="list-style-type: none"> Contractor must ensure clear delineation of construction work areas to avoid unnecessary vegetation clearance and soil loosening; The contractor must implement planned erosion control measures to avoid erosion in areas that are prone to erosion, e.g. steep slopes and drainage lines; Topsoil stockpiles will be vegetated to prevent erosion; No topsoil to be utilized during any construction activity; Implement soil conservation measures at stockpiled sites; Where feasible, topsoil must be reinstated and rehabilitated on top of sub soil; All excavation works must be properly backfilled and compacted; Ensure downstream water users are informed about | Contractor | Construction | No additional cost to BOQ |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|------------------------------------|---|------------------------------|--------------|---------------------------|
| | | <p>any unprecedented release of heavily silted water into the river;</p> <ul style="list-style-type: none"> Where possible, construction activities should be scheduled to occur outside of the rainy season, to reduce the anticipated volume of runoff during construction; and Sediment traps and barriers must be employed due to steep terrain. | | | |
| Use and servicing of fossil fuel powered plant; Oil storage; Concrete production and use | Soil pollution | <ul style="list-style-type: none"> No vehicle/plant maintenance shall take place on undesignated site. In case of emergency, a drip tray shall be used to avoid diesel and / or oil spills; Concrete mixing shall not be done on bare soil. Concrete must be mixed on mortarboards, a large metal sheet or concrete slab. The slabs for concrete mixing shall be removed on completion of construction works; Excavated material shall be stockpiled at a demarcated site, within the construction zone; Once the construction activities have terminated, rehabilitation | Contractor | Construction | No additional cost to BOQ |
| Deployment of heavy plant and earthworks | Soil compaction | <ul style="list-style-type: none"> Vehicles must be kept on existing/designated roads/tracks where possible; Minimize compaction during stockpiling by working the soil in the dry state; Rip compacted areas to reduce runoff and re-vegetate where required; All topsoil and other soil profiles must be managed strictly. | Contractor | Construction | No additional cost to BOQ |
| Various construction activities | Surface and ground water pollution | <ul style="list-style-type: none"> Implement Standard Operating Procedures (SOPs) for working in water, including checks on equipment condition (especially leaks of oils, fuel, hydraulics), refuelling protocols (at safe location away from water, availability of spill kits and knowledge of their use, and | Contractor | Construction | 3,000,000 |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|--|---|------------------------------|--------------|-----------------------|
| | | <p>emergency spill procedures);</p> <ul style="list-style-type: none"> • Any on site/camp storage areas for fuels, oils or other liquid chemicals would be sited away from surface water drains. They must have an impermeable base and bund with a capacity of 110% and would not drain directly into the surface water drains. Where practicable, drainage from storage compounds would be passed through oil interceptors prior to discharge; • Apply standard best practice site sediment control procedures (e.g. settling ponds) to minimise sediment in site drainage waters returning to the river; • Ensure all staff and workers are fully aware of the limits to the site for each activity, SOPs, and emergency procedures; • Ensure that all construction equipment and vehicles are serviced off site at licensed garages; • Any contaminated soil should be handled properly as hazardous waste and removed from site for safe disposal; and • Careful management of the sites and education of all construction staff would curtail the risk of pollution spills. | | | |
| Construction camps | Overstretching local utilities; and incidences of insecurity | <ul style="list-style-type: none"> • Careful planning of construction camp; • Any contractor's camp should have a comprehensive waste management and sanitation plan and facilities commensurate with population of workers and activities in the camps; • Any storage tanks and equipment should have correct labels and Material Safety Data Sheets; • Adequate Emergency Response Plan should be in place in the camps; • The contractor should employ best practice management "housekeeping" (site cleanliness, waste disposal etc.) at all times; | Contractor | Construction | 2,000,000 |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|--|--|------------------------------|--------------|-------------------------|
| | | <ul style="list-style-type: none"> The contractor's facilities should be completely removed from site after use and the land restored to its previous condition or better; AWSB in collaboration with the local administration can facilitate the development of a police post next to the camp area to increase security. | | | |
| Handling hydrocarbons on site | Oil spills | <ul style="list-style-type: none"> Vehicle maintenance should be done on purpose-built impervious concrete platforms with oil and grease traps; Ensure that all equipment are in good condition, clean and free from leaks; Oil spill containment and cleanup equipment should be kept at the contractor's camp. Construct oil skimming tanks at the locations directed and in accordance with details approved by the Engineer. Oil recovered from the skimming tanks shall be stored in drums and removed from the site for safe disposal; Monitor effluent discharge from the oil skimming tanks. Effluent discharge shall not exceed 25 mg/litre or the limit specified by the NEMA. | Contractor | Construction | 2,500,000 |
| Employment of locals | Shifting of labour from tea picking to construction; Increased school drop-outs as school going age-group seek to work on the project | <ul style="list-style-type: none"> The contractor should be encouraged to offer wages within the prevailing rates; Where feasible, labour intensive tunnel construction activities should be planned to occur during off-peak periods for tea picking; and Contractor must abide by labour laws and avoid any employment of children. | Contractor | Construction | No addition cost to BOQ |
| Diversion weirs and associated weir construction works | Interference with migratory fishes | <ul style="list-style-type: none"> Minimize activities to areas of construction and initiate habitat restoration immediately after construction works are through; Ensure sufficient compensation flow; and Restore disturbed areas to near-to-nature to blend with the immediate environment. | Contractor | Construction | 800,000 |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|---|---|------------------------------|--------------|-----------------------|
| Oil spills and sediments releases | Riverine microhabitat alterations; Loss of otter dens; and Loss of breeding and nursery grounds for fishes and invertebrates such as the freshwater crabs <i>Potamonautes spp</i> | <ul style="list-style-type: none"> • Ensure adequate waste management plan is in place and in use from the onset of construction; and • Oil spill containment and clean-up equipment should always be available at the construction site with trained response team; • Implement erosion and sediment management plan; • Systematic search, capture and safe release of otters inhabiting the right of way (for the weir structures) and fish pass); and • Selective clearing and restoration of vegetation after construction | Contractor and KWS | Construction | 2,000,000 |
| Site clearance and earthworks | Loss of vegetation cover and Illegal logging of trees of conservation significance | <ul style="list-style-type: none"> • Strictly control vegetation clearance and ensure it is only done when absolutely necessary through delineation of works areas; • Compensate for affected tea bushes and tree/woodlots before construction works begin and allow for salvage of affected timber; • Re-vegetate disturbed areas with locally occurring grasses, shrubs and indigenous trees soon after completion of each section; • Where encountered, plants of conservation importance should be avoided as feasible; • Establish and enforce code of conduct for its employees which must among others abhor illegal logging even from chance encounters of protected tree species within the project area; and • Ensure compliance with Wildlife (Conservation and Management) Act, 2013 and sensitize employees on the same. | Contractor | Construction | 1,800,000 |
| Tunnel construction | Spoil generation | <ul style="list-style-type: none"> • Maximise the re-use of excavated materials in the works as far as feasible; • Investigate opportunities to set up MOU for use of spoil material elsewhere by the county government (e.g. for road construction and rehabilitation). | | | |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|---------------------------|--|------------------------------|--------------|-----------------------|
| | | <ul style="list-style-type: none"> Properly dispose off the spoil in the approved spoil sites identified by the design team; and Implement erosion and siltation management plan. | | | |
| Solid Waste generation | Waste handling challenges | <ul style="list-style-type: none"> The contractor should enforce the appropriate management methods based on the three Rs (Reduce, Reuse, and Recycle). For waste handling the contractor should provide litter collection facilities such as bins; Final disposal of the site waste should be done at a location that shall be approved by Resident Engineer in accordance with the Waste Management Plan after consultation with the relevant stakeholders, including the County Administration and local community; The disposal site need to be more than 100 meters from watercourses and in a position that will facilitate the prevention of storm-water runoff from the site from entering the watercourse; The tender documents should specify proper solid waste handling as provided in the waste management plan during site preparation phase of construction prior to project works commencing in identifying optimal waste re-use options and licensed disposal areas. This should strictly be adhered to by the Contractor; The Contractor should not burn chemical or hazardous wastes on site or dump in open pits; and Maximise the re-use of all excavated materials in the works | Contractor | Construction | 1,500,000 |
| Generation of construction wastes | Liquid waste pollution | <ul style="list-style-type: none"> All grey water runoff or uncontrolled discharges from the site/working areas (including wash-down areas) to water courses should be contained and properly channelled; Water containing such pollutants as cements, concrete, lime, chemicals and fuels shall be discharged into a | Contractor | Construction | 1,300,000 |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|--|---|------------------------------|--------------|-----------------------|
| | | <p>conservancy tank for removal from site;</p> <ul style="list-style-type: none"> • Potential pollutants of any kind and in any form shall be kept, stored and used in such a manner that any escape can be contained and the water table not endangered; • Wash areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas (including groundwater) are not polluted; and • Act promptly on any pollution incidents on site. • | | | |
| Air quality and dust emissions | Dust nuisance and toxic emissions with respiratory health problems | <ul style="list-style-type: none"> • Sensitize workers on management of air pollution from vehicles and machinery; • Vehicles delivering soil materials should be covered to reduce dust emissions; • Activities generating dust (excavation, handling and transport of soils) to be carried out in calm weather. The Resident Engineer shall suspend earthworks operations wherever visible dust is affecting properties adjoining the work site; • Consider watering of the access roads during dry season to suppress dust; • Provide dust masks to all personnel on dust-prone work sites; • Records of related complaints should be kept by the contractor and communicated to the Resident Engineer; • All construction machinery should be maintained and serviced in accordance with the equipment specifications and manufacturer's standards; and • The removal of vegetation shall be avoided until such time as clearance is required and exposed surfaces shall be re-vegetated or stabilised as soon as practically possible. | PIU and Contractor | Construction | 600,000 |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|--|---|------------------------------|--------------|-----------------------|
| Noise generation by construction activities | Noise nuisance and related health problems | <ul style="list-style-type: none"> Noise levels shall be kept within acceptable limits preferably as stipulated within the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) Control Regulations, 2009 and construction activities shall, where possible, be limited to normal working hours; Monitor noise and vibration in sensitive locations above the tunnel (hospitals, teaching facilities, churches) and along the haulage routes to ensure the NEMA requirements regarding noise and vibration are met and if the standards are exceeded measures must be taken to reduce noise and vibration; Equipment should be maintained regularly to reduce noise resulting from friction; Workers exposed to high-level noise must wear personal protective equipment (PPE); Use of silencers on the construction plant, where applicable, should be encouraged; Residents in close proximity should be given at least 24 hours notification of any abnormal noise source e.g. planned blasting; and Institute a community complaints/redress mechanism to identify and respond to any unanticipated noise/vibration related complaints. | Contractor | Construction | 1,600,000 |
| Use fossil fuels and Air conditioners in camps | Generation Ozone depleting gases | <ul style="list-style-type: none"> Ensure use of approved fuels from licensed suppliers only; Regular maintenance of machinery to manufactures' specifications; Ensure that any cooling units installed at the camps only use ozone friendly coolants in compliance with NEMA guidelines. | Contractor | Construction | No addition to BOQ |
| Influx of immigrant workers | Social delinquency and spread of STIs including HIV/AIDS | <ul style="list-style-type: none"> Ensure the contractor liaises with local public health officials and NGO's within the project area in educating the community; | Contractor | Construction | No addition to BOQ |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|---|--|------------------------------|--------------|-----------------------|
| | | <ul style="list-style-type: none"> Locate construction camps locations away from concentration of schools; Formation of peer groups from among the project staff to ensure continuity in training and awareness raising; and The contractor should ensure that the project workers are sensitised on the local culture. | | | |
| Construction traffic | Traffic inconveniences and damage to local roads | <ul style="list-style-type: none"> Ensure the local roads and bridges to be used by the project are improved before construction works start; Ensure that all regulations relating to traffic management are observed and notify the local traffic officials and KTDA of the construction activities; Where necessary, traffic management plan should be developed together with alternative arrangements / diversions. The plan should define the construction routes and speed limits; and Install adequate and appropriate traffic warning signage and associated road furniture as well as enforcing speed limits for construction vehicles on the project affected roads. | Contractor | Construction | No addition to BOQ |
| Various construction activities | Safety and health risks to workers and the general public | <ul style="list-style-type: none"> Develop Construction Safety and Health Policy in compliance with OSHA, World Bank and international best practice e.g. IFCs Environmental, Health and Safety Guidelines. The policy should be approved by Environment, Health and Occupation Officer from AWSB and DOSH; Establish and enforce a strict code of conduct for all project drivers including outside suppliers delivering materials. The code should focus on safety, especially speed, and loading, especially banning all carriage of staff, workers and passengers except in seats; Implement the specified H&S programme throughout the construction period; | Contractor | Construction | No addition to BOQ |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|--|--|------------------------------|---------------------|-----------------------|
| | | <ul style="list-style-type: none"> The contractor should establish an emergency response procedure and display on all work areas during construction activities; Construction sites should be adequately barricaded from the general public and conspicuous warnings posted in national and local languages; and The contractor should ensure compliance with all standards and legally required health and safety procedures in line with OSHA, 2007 and associated rules and regulations. | | | |
| | | <ul style="list-style-type: none"> Include a specific and independent task in the supervision contract concerning H&S supervision and compliance, together with the staff resources to carry this out. | AWSB | Before construction | 2,000,000 |
| Camp and plant installation | Pressure on and disruption of utility services | <ul style="list-style-type: none"> Ensure any power demand beyond the existing capacity is installed before construction begins; Liaise with relevant utility service providers and roads authorities to minimize any service disruptions; Ensure advance notice to all stakeholders including water service providers and KTDA of any planned disruptions | Contractor | Construction | No addition to BOQ |
| Earthworks and spoil stockpiling | Modification of landscape | <ul style="list-style-type: none"> Encourage reuse of spoil materials e.g. in roads construction and maintenance, as far a feasible to reduce land area used for spoil storage; and Incorporate landscaping at adits and portals to camouflage the introduced concrete surfaces. | Contractor | Construction | 2,000,000 |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|--|--|-------------------------------------|-------------------|------------------------------|
| Influx of immigrant workers | Growth of unplanned settlements | <ul style="list-style-type: none"> As much as feasible, the unskilled labour should be obtained from amongst the locals; Provide adequate accommodation for non-local workforce; and Liaise with Murang'a county government to control developments in the area and ensure provision of adequate services | Contractor | Construction | No addition to BOQ |
| Tunnelling works | Destruction of previously unidentified physical cultural resources | <ul style="list-style-type: none"> Formulate a chance-find procedure for implementation whenever any archaeological sites are encountered | Contractor | Construction | 500,000 |

8.3.5 Operation Environmental and Social Management Plan

Table 8-2: Operation ESMP

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|--|--|------------------------------|------------|-----------------------|
| Water diversion into the tunnel | Reduced downstream flow (affecting both domestic and ecological needs) | <ul style="list-style-type: none"> Ensure strict adherence to the proposed abstraction weirs operation principles; Construct fish passes as planned and ensure they are regularly maintained to allow safe passage for all identified migratory species; Deliberate, compensation release of adequate amount of water downstream to mitigate alteration of the river ecosystem | AWSB and NCW&SC | Operation | No additional cost |
| | | <ul style="list-style-type: none"> Undertake wet season survey and subsequent annual aquatic fauna surveys for both wet and dry seasons to monitor trends and inform any further management interventions | AWSB | Operation | 10,000,000 |
| | | <ul style="list-style-type: none"> The Aberdare catchment conservation efforts should be enhanced to reduce possible sedimentation in to northern collector rivers, which may end up in the Thika reservoir, causing sedimentation of the reservoir Ensure demarcation and protection of riparian reserves of the affected rivers. This will offer favourable cover and temperatures for the rainbow trout | KFS KWS WRMA AWSB | Operation | |
| | | <ul style="list-style-type: none"> Conduct routine In-stream Flow Release compliance audit/monitoring once operation commences and use gathered information to guide management interventions. | WRMA | Operation | 10,000,000 (annually) |
| | Reduced water temperatures downstream | <ul style="list-style-type: none"> Encourage local communities to plant indigenous trees on the riparian lands to ensure water temperatures are not increased; | AWSB, NEMA and WRMA | Operation | |
| Deterioration of downstream water quality | <ul style="list-style-type: none"> Conduct regular water sampling and laboratory analysis to monitor the water quality variations | WRMA | Operation | | |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|---|---|------------------------------|------------|---|
| | Increased inflow into Githika river and Thika reservoir | <ul style="list-style-type: none"> For possible increased inundation of the riverine areas, stream channel expansion from the outfall may help to counter the increased flow. Installation of a gauging station after outfall, will help monitor the water levels changes, so as appropriate measures can be taken; and Ensure that the new off take is continuously operational at optimal levels to evacuate the increased volumes; | AWSB | Operation | No additional cost after implementation of pipeline component |
| | Changes in riverine and riparian floral compositions | <ul style="list-style-type: none"> Observe the minimum ecological flow after intake for R. Maragua, R. Irati and R. Gikigie; Support local communities to plant indigenous trees along the rivers and not the exotic Eucalyptus trees as is the present case. Awareness on the same should be enhanced; Undertake continuous ecological monitoring of hydrophytes and high water specific species to track and mitigate any emerging impacts of the project on the plants. | AWSB | Operation | 6,000,000 |
| Water diversion into the tunnel | Changes in riverine and riparian floral compositions | <ul style="list-style-type: none"> The riparian extent of the project affected rivers should be defined by WRMA (based on the 6-30m rule from river banks) and be enforced to prevent people farming up to the river banks to reduce siltation | NEMA and WRMA | Operation | No additional cost |
| Tunnel O&M activities | Safety risks during tunnel maintenance operations | <ul style="list-style-type: none"> AWSB should establish and implement NCT1 tunnel specific comprehensive O&M Safety and Health Management Plan within which it ensures that: <ul style="list-style-type: none"> All potential hazards are identified and appropriate mitigations put in place; Pre-entry activities are defined including the method statements, hazards assessment, incident action plan, communication plan, personnel accountability plan, personal protective equipment list, and atmospheric monitoring equipment list; | AWSB | Operation | |

| Project Activity/ environmental concern | Possible Impacts | Mitigation Measures | Institutional Responsibility | Time Frame | Estimated Costs (KES) |
|--|---------------------------|---|------------------------------|----------------------|---------------------------|
| | | <ul style="list-style-type: none"> • Appropriate PPE for O&M staff are available throughout; • Requisite instrumentation and available and operable; • Liaise with the Ministry of Health should to ensure clinic and ambulances to be built/acquired under the project remain operational in the project area throughout the operational life | | | |
| Increased inflow into Thika dam | Concerns of dam safety | <ul style="list-style-type: none"> • Review and update the existing safety and Emergency Plan for Thika dam. | AWSB | Before commissioning | To be determined by AWSB |
| Tunnel leaks | Loss of water | <ul style="list-style-type: none"> • Monitor volumes at intakes and outfall to allow loss detection; and • Ensure regular inspection and maintenance of the tunnel. | AWSB and NCW&SC | Operation | No additional cost |
| Fish pass failure | Impeded migration of fish | <ul style="list-style-type: none"> • Test and evaluate efficacy of fish passes within the first two years of commissioning | AWSB and NCW&SC | Operation | Operation and Maintenance |

8.4 Environmental and Social Monitoring

The overall objective of environmental and social monitoring is to ensure that mitigation measures are implemented and that they are effective. Environmental and social monitoring will also enable response to new and developing issues of concern. The activities and indicators that have been recommended for monitoring are presented in the ESMP.

Environmental monitoring is also carried out to ensure that all construction and operation activities comply and adhere to environmental provisions and standard specifications, so that all mitigation measures are implemented. The contractor shall employ an officer responsible for implementation of social/environmental requirements. This person will maintain regular contact with PIU and the respective County Environmental Officers. The contractor and PIU have responsibility to ensure that the proposed mitigation measures are properly implemented during the construction phase.

The environmental monitoring program will operate through the construction, and operation phases. It will consist of a number of activities, each with a specific purpose with key indicators and criteria for significance assessment.

Monitoring includes:

- Selection of environmental parameters;
- Visual observations; and
- Regular sampling and test measurements of these parameters.

Periodic ongoing monitoring will be required during the life of the Project and the level can be determined once the Project is operational.

Monitoring will be done in three fronts:

- Physical monitoring;
- Biological monitoring; and
- Social monitoring.

8.4.1 Internal monitoring

It is the responsibility of the proponent, AWSB through the PIU , to conduct regular internal monitoring of the project to verify the results of the Contractor and to audit direct implementation of environmental mitigation measures contained in the ESMP and construction contract clauses for the Project.

The monitoring should be a systematic evaluation of the activities of the operation in relation to the specified criteria of the condition of approval.

The objective of internal monitoring and audit will be:

- To find out any significant environmental and safety and health hazards and their existing control systems in force; and
- Meeting the legal requirements as stipulated in the Environmental Management & Coordination Act, EMCA-1999 and OSHA, 2007.

8.4.2 External monitoring and evaluation

It is recommended that a consultant be hired to carry out Annual Environmental Audits in line with NEMA requirements. NEMA has the overall responsibility for issuing approval for the Project and ensuring that their environmental guidelines are followed during Project

implementation. Its role therefore is to review environmental monitoring and environmental compliance documentation submitted by the implementing authorities and they would not normally be directly involved in monitoring the Project unless some specific major environmental issue arose.

AWSB through the consultant will therefore provide NEMA with reports on environmental compliance during implementation as part of their progress reports and annual environmental auditing reports. Depending on the implementation status of environmentally sensitive project activities, NEMA may perform annual environmental reviews in which environmental concerns raised by the project will be reviewed alongside project implementation.

Table 8-3: Monitoring Plan

| Environmental Component | Parameter | Standard | Location | Frequency | Implementation | Supervision |
|--|---|--------------------------|---|--|----------------|------------------------|
| Land take and resettlement | Signed consent forms and compensation paid as per land and crop valuation | Valuation roll | Conveyance line | Monthly until construction is complete | AWSB | Supervision Consultant |
| Noise levels | Complaints; and Noise levels on dB (A) scale | EMCA guidelines on Noise | Selected Sites | As directed by the supervision consultant | Contractor | Supervision Consultant |
| Air Quality | Total suspended particles , H ₂ S, CO ₂ , CH ₄ | EMCA and WHO guidelines | Populated areas | Monthly | Contractor. | AWSB |
| Soil Quality | pH ECe Exchangeable sodium percentage (ESP) Sodium adsorption ratio (SAR) Organic matter Cation Exchange Capacity (CEC) Nitrates P, K, Ca status | FAO and Soils Report | Composite samples from mineral soil at 5-30 cm depth, each sample to represent ~16 ha | Quarterly | Contractor | AWSB |
| Groundwater depth | Depth to groundwater | WRMA Guidelines | Existing boreholes and wells | Monthly | O&M Contractor | AWSB and WRMA |
| Groundwater quality | pH Salinity (EC) Nitrates Phosphorous Pesticide residues | WRMA Guidelines | Existing boreholes and wells | Monthly Monthly 6 months 6 months if indicated by drainage or surface water tests | O&M Contractor | AWSB and WRMA |
| Surface water quality – intakes and receiving waters | pH Salinity (EC) Nitrates Phosphorous Pesticide residues Coliforms BOD COD | EMCA Guidelines | Intake points and selected points downstream of irrigation areas | Monthly Monthly 6 months 6 months Monthly Monthly Monthly | O&M Contractor | AWSB |

| Environmental Component | Parameter | Standard | Location | Frequency | Implementation | Supervision |
|---|--|---|---|------------------------------------|----------------------|------------------------|
| Solid waste | Slag, domestic refuse, metallic scraps, sludge | Disposal sites | Quarterly | Daily | AWSB and Contractor. | Supervision Consultant |
| Soil Erosion | Turbidity in rivers and storm water | NEMA guidelines | Site, Marjory on river bank | During and after the rainy seasons | Contractor | Supervision Consultant |
| Rehabilitation of work sites | Monitoring to ensure all work sites are progressively rehabilitated | ESMP | site | As required | Contractor | Supervision Consultant |
| Accidents | Occupational safety and health adviser engaged; Safety procedures; Safety training for workers, accident reports, community consultations and feedback | ESMP | Project area | Quarterly | Contractor | AWSB and DOSH |
| Health | Project Health facilities Project Ambulances Signs, posters displayed, health awareness campaigns conducted, | ESMP | Project area | Monthly | Contractor | AWSB |
| Vegetation and habitats | Vegetation structure, species density, diversity, fuel wood usages and illegal logging incidences | ESMP | Project area and environs | Annually | Contractor | AWSB |
| Aquatic environment | Flow velocity Wetted perimeter PH Depth Salinity Turbidity Habitat connectivity | ESMP | All project rivers up to the confluence with Sagana | Quarterly | Contractor | AWSB |
| Seismic risks | Instrumentation installed | ESMP | Tunnel | Quarterly | Contractor | AWSB |
| Efficiency at waste water treatment works for the Nairobi City County | Effluent quality indicators | Design specifications and Water Quality standards | All waste water treatment works | Quarterly | AWSB | NEMA |

9 CONCLUSION AND RECOMMENDATIONS

9.1 Conclusions

This ESIA Study has been prepared to provide sufficient and relevant information on the proposed Northern Collector Tunnel Phase 1, to enable NEMA establish whether activities of the project are likely to have significant adverse environmental impacts.

Generally, the proposed project will result in appreciable benefits to the city of Nairobi, its satellite towns and Kenya at large and bring opportunities for both social and economic development.

The main social impact management issues on the project revolve around relocation of people within the project area and acquisition of land for development of weirs, adits/portals and outfall as well as restriction of use of land (11.8 x 3m) above the tunnel alignment. These will result in loss of approximately 18.87 acres of land and displacement of 161 persons and 7 institutions.

From hydrological analysis, the project is not anticipated to have any significant impacts on hydrology. Since the project design is based on flood flow of the rivers, no changes on normal flows are anticipated at all. However, frequencies of flood flows downstream will be reduced. The cumulative impacts of the project on downstream hydropower generation schemes at Masinga has also been established to be marginal with an annual average reduction of inflow of 2.32% to Masinga Reservoir, or a reduction in volume of 2.72 m³/s relative to average inflow of 125.51 m³/s (1995-1997).

On ecology, assessment of the project induced hydrological changes against habitat requirements for rainbow trout fish, *Onchorynchus mykiss* which was found to have the stringest flow requirements among documented species. The study established that the proposed flow release for Maragua intake (Q95=0.481 m³/sec) will meet the trout fish requirement (0.259 m³/sec). However, for Irati and Gikigie rivers, the proposed downstream releases will be lower than the calculated minimum requirements for the trout species. The proposed design for Irati is 1.4Q95=0.645 m³/sec against calculated rainbow trout fish requirement of 0.989 m³/sec while for Gikigie, the proposed design flow is Q95 = 0.101 m³/sec, against rainbow trout requirement computed to be 0.133 m³/sec. In order to meet the calculated rainbow trout fish minimum habitat requirements, hydrological analysis established that the design flows at Gikigie and Irati intakes would require upward revisions to 1.32xQ95=1.33 m³/sec and 2.15xQ95=0.991 m³/sec respectively.

It is notable that the calculated minimum requirements for rainbow trout from this study are higher than the naturalised mean monthly flow e.g. for Irati river and cannot be therefore used to set the minimum ecological flow requirements. This could also mean that the rainbow trout species is not distributed throughout all the rivers in all seasons hence the need to ensure that any migration is not impeded for continuous habitats connectivity. The study therefore recommends the implementation of the compensation flow as designed but with strict enforcement of the proposed operating principles.

Since the proposed project abstractions will be based on flood flow and not normal flows, there will be no effect at all on the normal flows. The anticipated reduced frequency of low-flows will be associated with some habitat loss for riverine fishes during periods of low-flows with Irati likely to be the most affected. However, no permanent riverine habitat loss is anticipated and there is no species of conservation significance that will be impacted.

The consultant wishes to state that most adverse impacts associated with the project can be readily managed to acceptable levels with implementation of the recommended mitigation measures for the Project such that the overall benefits from the Project will greatly outweigh

the adverse impacts. Further, the requisite conditions for most of the mitigations have been incorporated by the proponent on project bidding documents reviewed by the consultant.

9.2 Recommendations

Implementation: It is recommended that the proposed project be implemented in compliance with all the relevant legislation and planning requirements of Kenya at all times. In line with this, the proponent (AWSB) and the contractor (s) must take the legislative framework reviewed in this report into consideration, during and after the implementation of the project, as will be appropriate.

Downstream ecology: In order to meet the downstream ecological requirements, the following are recommended:

- Ensure the proposed abstraction weirs operation principles are met throughout the operation period for all rivers via continuous monitoring. Reduced abstractions during low-flow seasons achieved by this will help sustain riverine habitats during these periods;
- Construct fish passes as planned and ensure they are regularly maintained to allow safe passage for all identified migratory species;
- Ensure demarcation and protection of riparian reserves of the affected rivers. This will offer favourable cover and temperatures for the rainbow trout; and
- Undertake wet season survey and subsequent annual aquatic fauna surveys for both wet and dry seasons to monitor trends and inform any further management interventions.

Adherence to ESMP: In addressing the environmental issues, the contractor and/or AWSB must follow the mitigation guidelines provided under ESMP. This will ensure the safety of operators and the neighbouring communities. It is also recommended that an independent and qualified safety and health adviser be incorporated in the proposed project management, during the entire construction phase. The safety officer will make sure that all the workers follow the safety rules.

Resettlement Action Plan: GIBB Africa recommends that a Resettlement Action Plan prepared alongside this ESIA study report be implemented before mobilisation of contractor to site and any additional land requirements by the contractor not covered under the RAP are included in the updated version of the document, consultations made with appropriate PAPs and stakeholders and implemented before actual construction begins.

Annual Environmental and Occupational Safety and Health Audits: AWSB should undertake separate Environmental Audit (EA) and Annual Occupational Safety and Health audits of the project, as required by the NEMA Regulations twelve (12) months after completion and OSHA, 2007 respectively. These can be done by seeking the services of an Consultants who should be Lead Agents registered by NEMA and advisers registered by DOSH. The team should consist of the following experts as a minimum:

- Lead Environmental Consultant (Senior Environmentalist/Team leader);
- Sociologist; and
- Occupational safety and health advisor.

Aberdare Watershed Management: It is notable that the Aberdare catchment is not only the lifeline for the project but also to the other major sources of water already developed by the proponent as presented in section 1.1 of this report. In overall, it is recommended that the proponent should actively participate in general Watershed Management for the Aberdare Catchment Area in collaboration with other identified institutions. Such participation should specifically focus on components on re/afforesting the forest and riparian areas of project rivers with indigenous species and sensitization of the local communities on the same. This

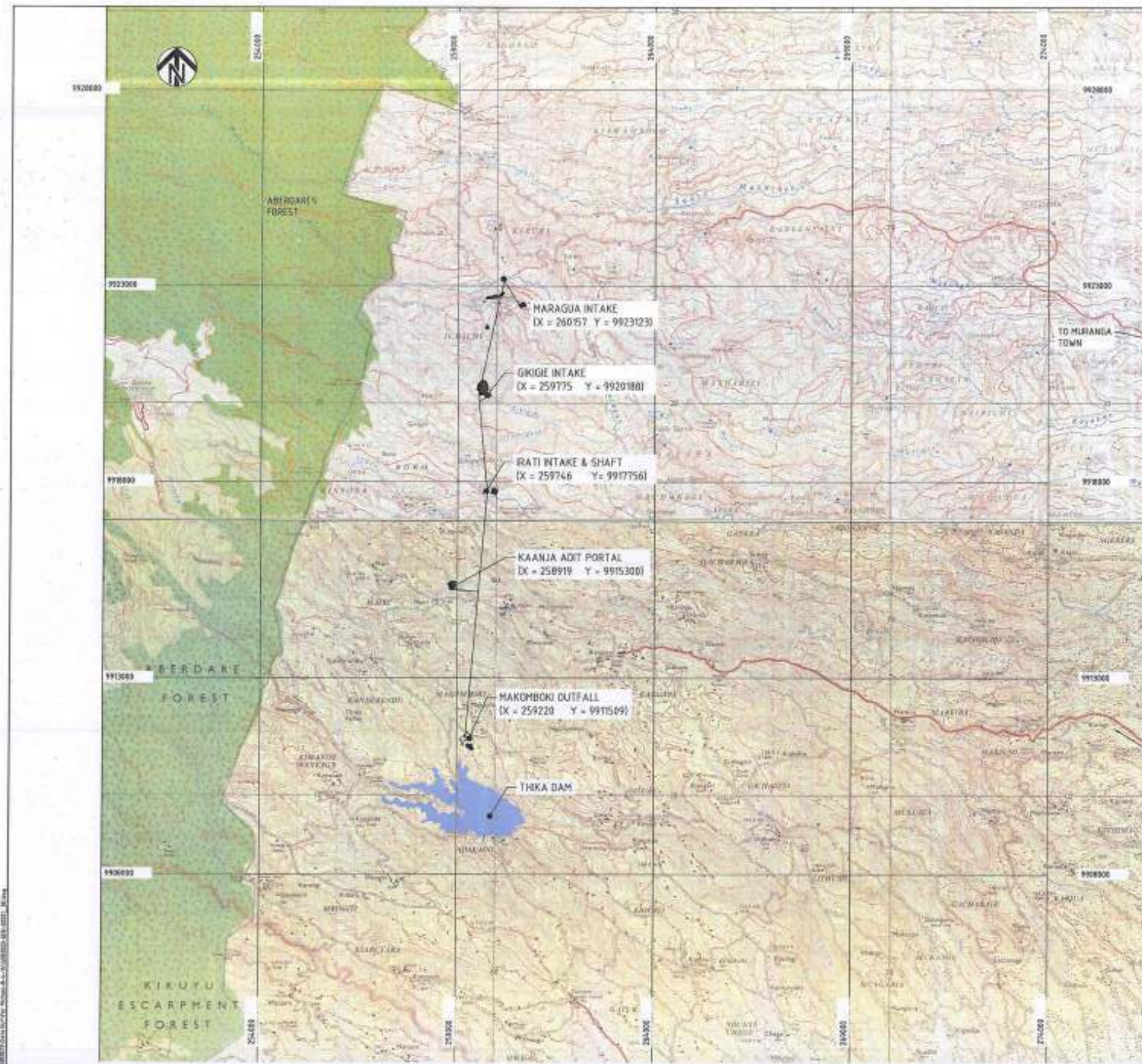
will not only help to mitigate any negative impacts that may arise from the current project such as reduced flows and soil erosion within the area but also realize general improvements on the catchment capacity to offer ecological and water production services.

10 BIBLIOGRAPHY

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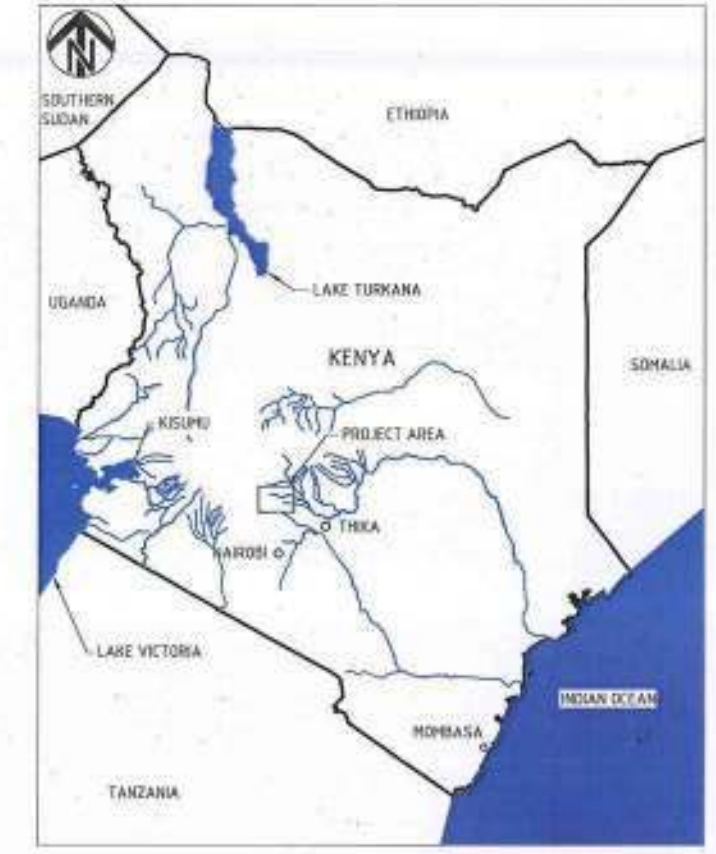
APPENDICES

Appendix I: Tunnel drawings



SITE LAYOUT
SCALE 1:41,935,000

ACCESS ROAD FROM
NAIROBI-THIKA HIGHWAY



PROJECT LOCATION PLAN
N.T.S

SCALE 1:200,000

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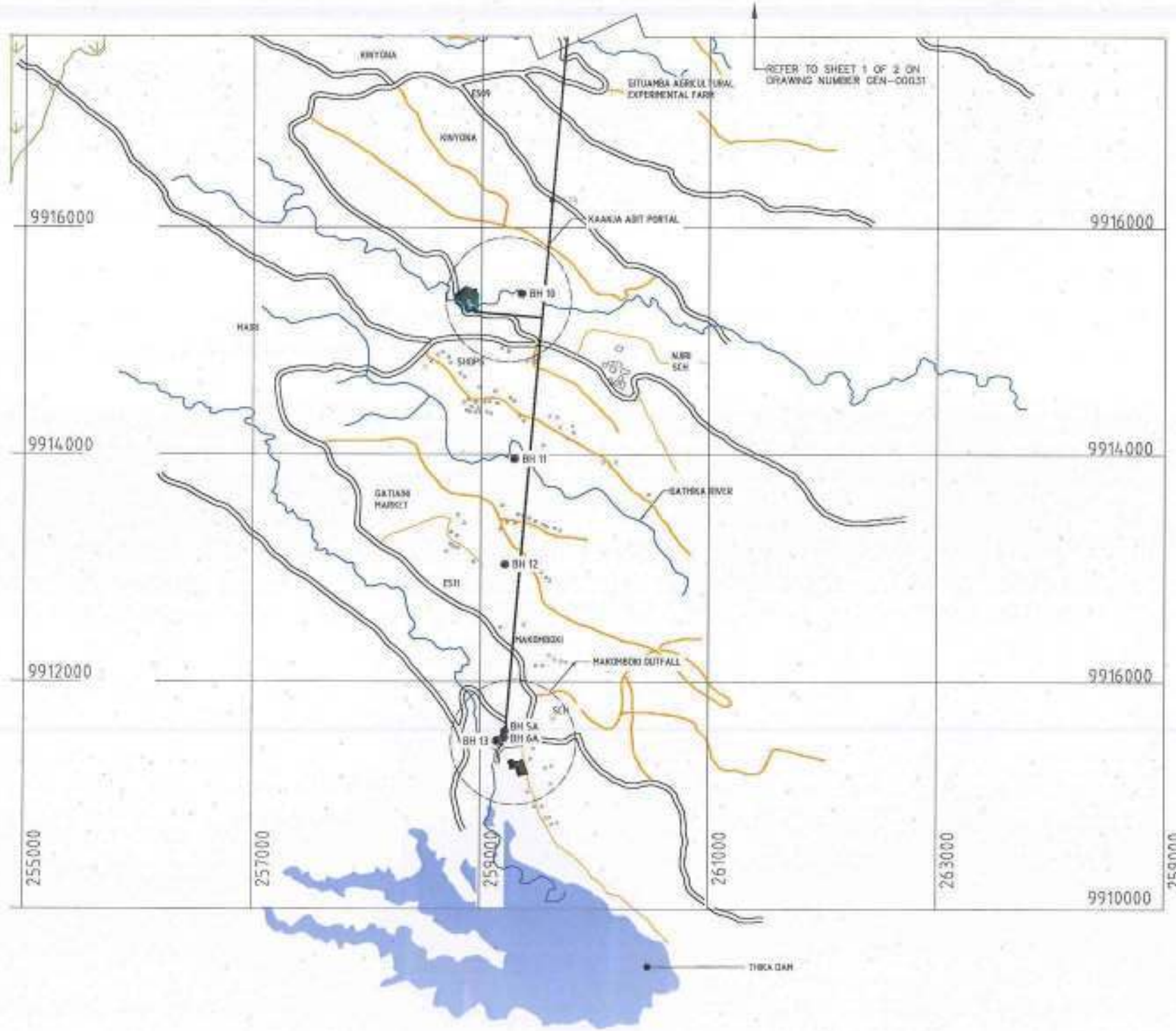
**NORTHERN COLLECTOR TUNNEL
PHASE 1**

LOCATION MAP

| | |
|----------------------|------------------|
| Drawn: E. RUAWA | Date: 02.08.2012 |
| Designed: J. WENGE | Date: 02.08.2012 |
| Checked: R. KIRUMBO | Date: 05.08.2012 |
| Approved: J. KIRUMBO | Date: 08.08.2012 |

| | |
|-------------------------------|----------------|
| Drawing No: 5063023-GEN-00021 | Revision: A |
| Drawing Scale: AS SHOWN | Sheet Size: A1 |
| Drawing Status: DRAFT | |

**TENDER DESIGN
NOT FOR CONSTRUCTION**



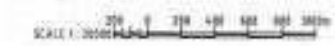
NOTES

1. REFER TO DRAWING 00021 FOR LOCATION MAP

LEGEND

- BOREHOLES
- TUNNEL
- FARMAC ROADS
- FARMHOUS ROAD
- RIVER
- BUILDINGS

| BOREHOLES | | |
|-----------|-----------|------------|
| POINT | X | Y |
| BH0 | 260999.78 | 9923098.6 |
| BH1A | 260977.26 | 9923094.19 |
| BH1A | 260909.87 | 9922936.68 |
| BH3A | 259899.31 | 99216163 |
| BH8 | 259860 | 9920792.52 |
| BH7 | 259442.35 | 991957.64 |
| BH8 | 259054.85 | 991723.84 |
| BH4A | 259151.77 | 991891.06 |
| BH7A | 25918.03 | 991624.23 |
| BH5A | 259236.86 | 991505.29 |
| BH6A | 259213.13 | 991508.87 |
| BH9 | 259253.43 | 991547.26 |
| BH7 | 259294.34 | 991390.46 |
| BH12 | 259213.7 | 991331.98 |
| BH13 | 259149.02 | 991484.36 |



| | | | |
|---|--------------|--|--|
| | | | |
| | | | |
| B | DRIFT TUNNEL | | |
| A | FASTDRAFT | | |
| | | | |
| | | | |

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Drafting Check: Date:

Civil Engineering Check: Date:

CONSULTANT:

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**NORTHERN COLLECTOR TUNNEL
PHASE 1**

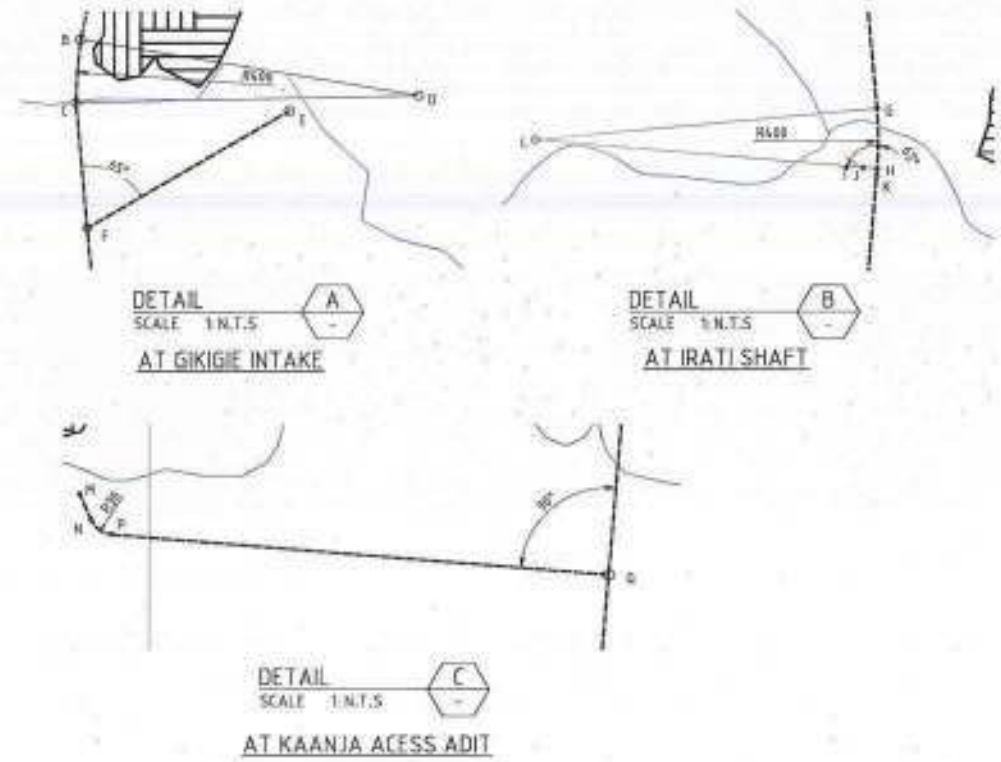
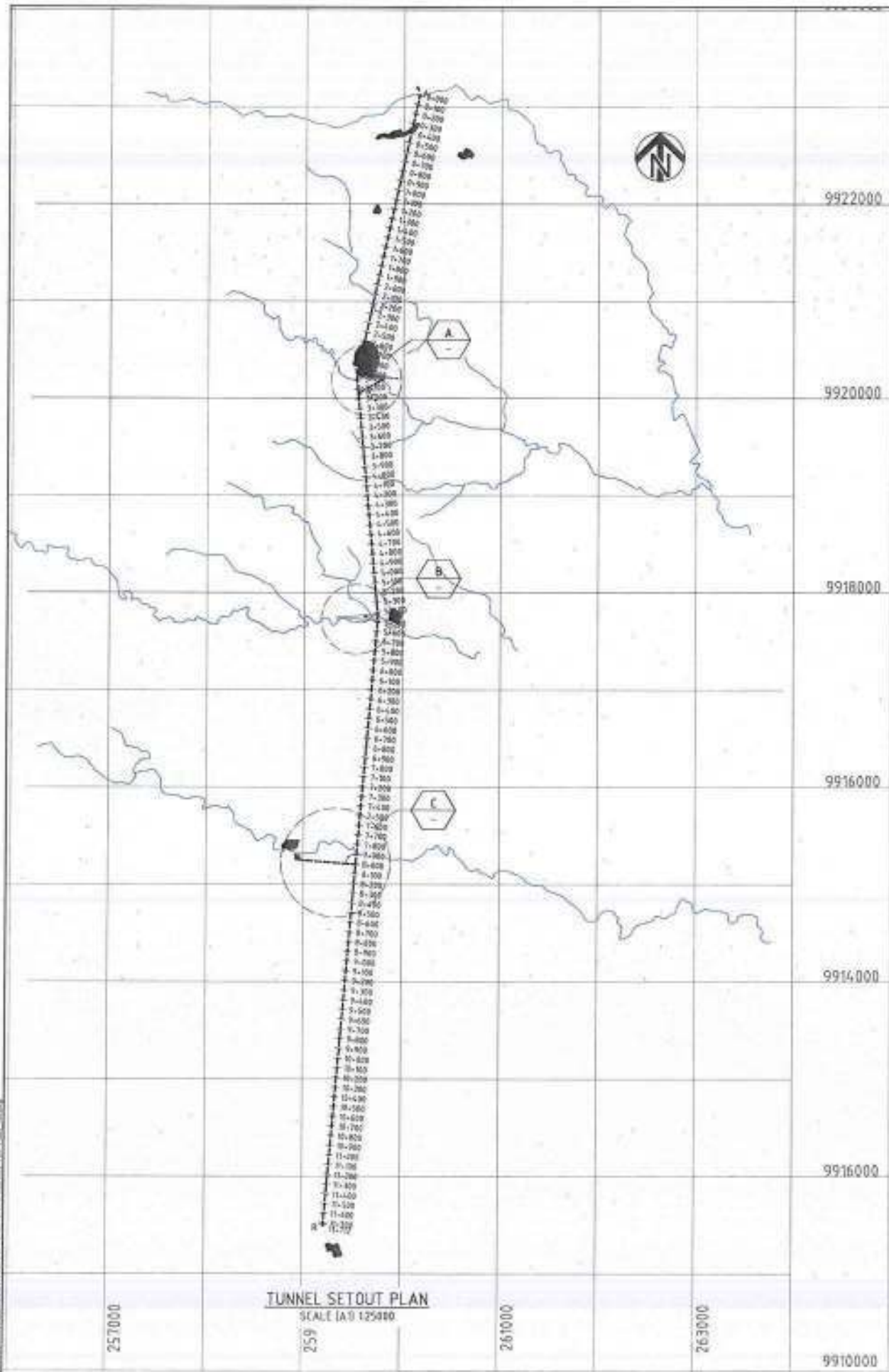
GENERAL ARRANGEMENT PLAN
SHEET 2 OF 2

| | | | |
|----------|-------------------|------|------------|
| Drawn | F. MUSA | Date | 01.09.2012 |
| Designed | M. WAHEDI | Date | 02.09.2012 |
| Checked | R. N. Y. Y. Y. Y. | Date | 03.09.2012 |
| Approved | G. K. K. K. K. | Date | 04.09.2012 |

| | | | |
|---------------|-------------------|------------|----|
| Drawing No. | 5083023-GEN-00032 | Revision | B |
| Drawing Scale | AS SHOWN | Sheet Size | AT |
| Printing Date | TENDER | | |

GENERAL ARRANGEMENT PLAN
SCALE (A3) 1:20,000

**TENDER DESIGN
NOT FOR CONSTRUCTION**



PROVISIONAL PENDING
GEO TECHNICAL INVESTIGATION

| COORDINATES | | | |
|--|-------|------------|------------|
| LOCATION | POINT | E | N |
| TUNNEL EP (PARADIA) | A | 259757.557 | 992021.879 |
| GIKIGIE - MAIN TUNNEL POINT | B | 259526.570 | 992022.175 |
| GIKIGIE - MAIN TUNNEL POINT | C | 259526.570 | 992022.175 |
| GIKIGIE - CTR RADIUS | D | 259926.483 | 991926.319 |
| GIKIGIE INTAKE POINT | E | 259775.984 | 992086.501 |
| GIKIGIE - MAIN TUNNEL CONNECTION POINT | F | 259546.017 | 991988.501 |
| IRATI - MAIN TUNNEL POINT | G | 259147.898 | 991782.588 |
| IRATI - MAIN TUNNEL POINT | H | 259748.045 | 991772.054 |
| IRATI - SHAFT | J | 259731.888 | 991772.770 |
| IRATI - MAIN TUNNEL CONNECTION POINT | K | 259747.405 | 991761.996 |
| IRATI - CTR RADIUS | L | 259749.437 | 991765.944 |
| KAAKJA ADIT - BP ADIT | M | 258919.113 | 991539.489 |
| KAAKJA ADIT POINT | N | 258932.129 | 991521.063 |
| KAAKJA ADIT POINT | P | 258959.215 | 991524.879 |
| KAAKJA ADIT/MAIN TUNNEL CONNECTION POINT | Q | 258531.213 | 991586.880 |
| TUNNEL EP (DITHIKA) | R | 259278.342 | 991584.266 |

| No. | Revision | Approved | Date |
|-----|--------------|----------|------------|
| B | DRAFT TENDER | | 04/05/2013 |
| A | FIRST DRAFT | | 04/05/2013 |

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**NORTHERN COLLECTOR TUNNEL
PHASE 1**

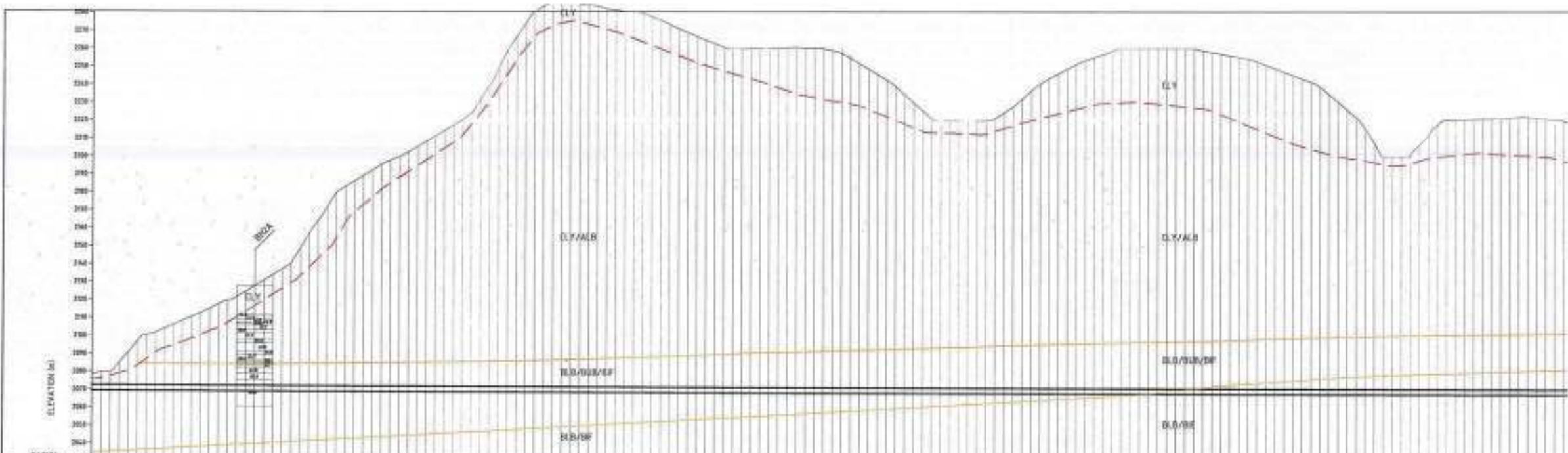
The **TUNNEL ADITS AND SHAFT
SET OUT POINTS**

| Drawn | W. MUEHM | Date | 16.09.2012 |
|----------|--------------|------|------------|
| Designed | F. CORTES | Date | 13.09.2012 |
| Checked | H. MEYERDELL | Date | 15.09.2012 |
| Approved | D. BIRNIE | Date | 21.09.2012 |

Drawing No: 5083023-TUN-01502
 Drawing Title: AS-SHOW
 Drawing Status: TENDER

Revision: **B**
 Sheet Size: **A1**

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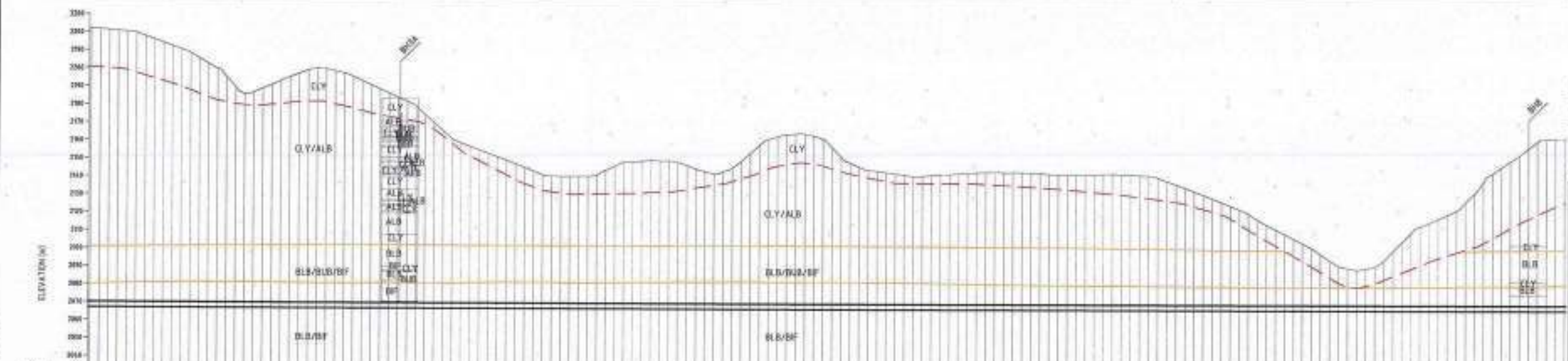
- NOTES:**
- EXISTING GROUND LEVEL AND DEPTH TO INVERT APPROXIMATE ONLY.
 - FOR SOIL/ROCK DATA, REFER TO DWG. TUN-0151.
 - FOR PRIMARY SUPPORT TYPE, REFER TO DWG. TUN-0152.

- LEGEND:**
- NATURAL SURFACE LEVEL
 - APPROXIMATED ROCK LEVEL
 - GEOLOGICAL BOUNDARY
 - TUNNEL

PROVISIONAL PENDING
GEO TECHNICAL INVESTIGATION

TENDER DESIGN
NOT FOR CONSTRUCTION

| CHAINAGE | INVERT LEVEL | NATURAL SURFACE LEVEL (NOTE 1) | DEPTH TO INVERT (M) | TUNNEL GRADIENT | PROVISIONAL GEOLOGICAL UNIT | PROVISIONAL PRIMARY SUPPORT |
|----------|--------------|--------------------------------|---------------------|-----------------|-----------------------------|---|
| 0+000 | 2078.88 | 2079.52 | 7.64 | -6.5% | BLB/BLB/BF | TYPE S1 & S2 UP TO 350m TOTAL AND TYPE S3 |
| 0+100 | 2068.95 | 2069.28 | 10.33 | | | |
| 0+200 | 2059.02 | 2059.54 | 10.52 | | | |
| 0+300 | 2049.10 | 2049.83 | 10.73 | | | |
| 0+400 | 2039.17 | 2039.50 | 10.33 | | | |
| 0+500 | 2029.25 | 2029.87 | 10.62 | | | |
| 0+600 | 2019.32 | 2019.94 | 10.62 | | | |
| 0+700 | 2009.40 | 2009.81 | 10.41 | | | |
| 0+800 | 2000.00 | 2000.00 | 10.00 | | | |
| 0+900 | 1990.10 | 1990.10 | 9.99 | | | |
| 0+1000 | 1980.20 | 1980.20 | 9.98 | | | |
| 0+1100 | 1970.30 | 1970.30 | 9.97 | | | |
| 0+1200 | 1960.40 | 1960.40 | 9.96 | | | |
| 0+1300 | 1950.50 | 1950.50 | 9.95 | | | |
| 0+1400 | 1940.60 | 1940.60 | 9.94 | | | |
| 0+1500 | 1930.70 | 1930.70 | 9.93 | | | |
| 0+1600 | 1920.80 | 1920.80 | 9.92 | | | |
| 0+1700 | 1910.90 | 1910.90 | 9.91 | | | |
| 0+1800 | 1901.00 | 1901.00 | 9.90 | | | |



| CHAINAGE | INVERT LEVEL | NATURAL SURFACE LEVEL (NOTE 1) | DEPTH TO INVERT (M) | TUNNEL GRADIENT | PROVISIONAL GEOLOGICAL UNIT | PROVISIONAL PRIMARY SUPPORT |
|----------|--------------|--------------------------------|---------------------|-----------------|-----------------------------|-----------------------------------|
| 1+800 | 2057.40 | 2057.28 | 0.12 | -6.75% | BLB/BLB/BF | TYPE S4 (UP TO 2050m) AND TYPE S1 |
| 1+900 | 2047.45 | 2047.45 | 0.00 | | | |
| 1+1000 | 2037.50 | 2037.50 | 0.00 | | | |
| 1+1100 | 2027.55 | 2027.55 | 0.00 | | | |
| 1+1200 | 2017.60 | 2017.60 | 0.00 | | | |
| 1+1300 | 2007.65 | 2007.65 | 0.00 | | | |
| 1+1400 | 1997.70 | 1997.70 | 0.00 | | | |
| 1+1500 | 1987.75 | 1987.75 | 0.00 | | | |
| 1+1600 | 1977.80 | 1977.80 | 0.00 | | | |
| 1+1700 | 1967.85 | 1967.85 | 0.00 | | | |
| 1+1800 | 1957.90 | 1957.90 | 0.00 | | | |
| 1+1900 | 1947.95 | 1947.95 | 0.00 | | | |
| 1+2000 | 1938.00 | 1938.00 | 0.00 | | | |
| 1+2100 | 1928.05 | 1928.05 | 0.00 | | | |
| 1+2200 | 1918.10 | 1918.10 | 0.00 | | | |
| 1+2300 | 1908.15 | 1908.15 | 0.00 | | | |
| 1+2400 | 1898.20 | 1898.20 | 0.00 | | | |
| 1+2500 | 1888.25 | 1888.25 | 0.00 | | | |
| 1+2600 | 1878.30 | 1878.30 | 0.00 | | | |
| 1+2700 | 1868.35 | 1868.35 | 0.00 | | | |
| 1+2800 | 1858.40 | 1858.40 | 0.00 | | | |
| 1+2900 | 1848.45 | 1848.45 | 0.00 | | | |
| 1+3000 | 1838.50 | 1838.50 | 0.00 | | | |

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| DRIFT TENDER | D.K. | 25.11.2012 |
| PROF DRAFT | D.K. | 21.08.2012 |
| Rev | Revision | Approved Date |

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Civil Engineering Check: _____ Date: _____

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**NORTHERN COLLECTOR TUNNEL
PHASE 1**

MAIN TUNNEL
LONG SECTION
SHEET 1 OF 4

| | |
|-----------------------|------------------|
| Drawn: WARDEN | Date: 18.09.2012 |
| Designed: F. CORRIE | Date: 11.09.2012 |
| Checked: R. HEVERGELT | Date: 19.09.2012 |
| Approved: D. KEMOND | Date: 25.09.2012 |

Drawing No: 5083023-TUN-01511

Drawing Scale: AS SHOWN

Drawing Date: TENDER

Revision: B

Sheet No: A1

NOTES:

- EXISTING GROUND LEVEL AND DEPTH TO INVERT APPROXIMATE ONLY.
- FOR SOIL/ROCK UNITS, REFER TO DWG. TUN-0150.
- FOR PRIMARY SUPPORT TYPE, REFER TO DWG. TUN-0153.

LEGEND:

- NATURAL SURFACE LEVEL
- APPROXIMATE ROCK LEVEL
- GEOLOGICAL BOUNDARY
- TUNNEL

PROVISIONAL PENDING
GEOTECHNICAL INVESTIGATION

TENDER DESIGN
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| 1 | DRAFT TENDER | D.K. | 25.11.2013 |
| 2 | TENDER DRAFT | D.K. | 27.08.2013 |
| Rev. | Revision | Approved | Date |

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 Civil Engineering Check: Date: _____



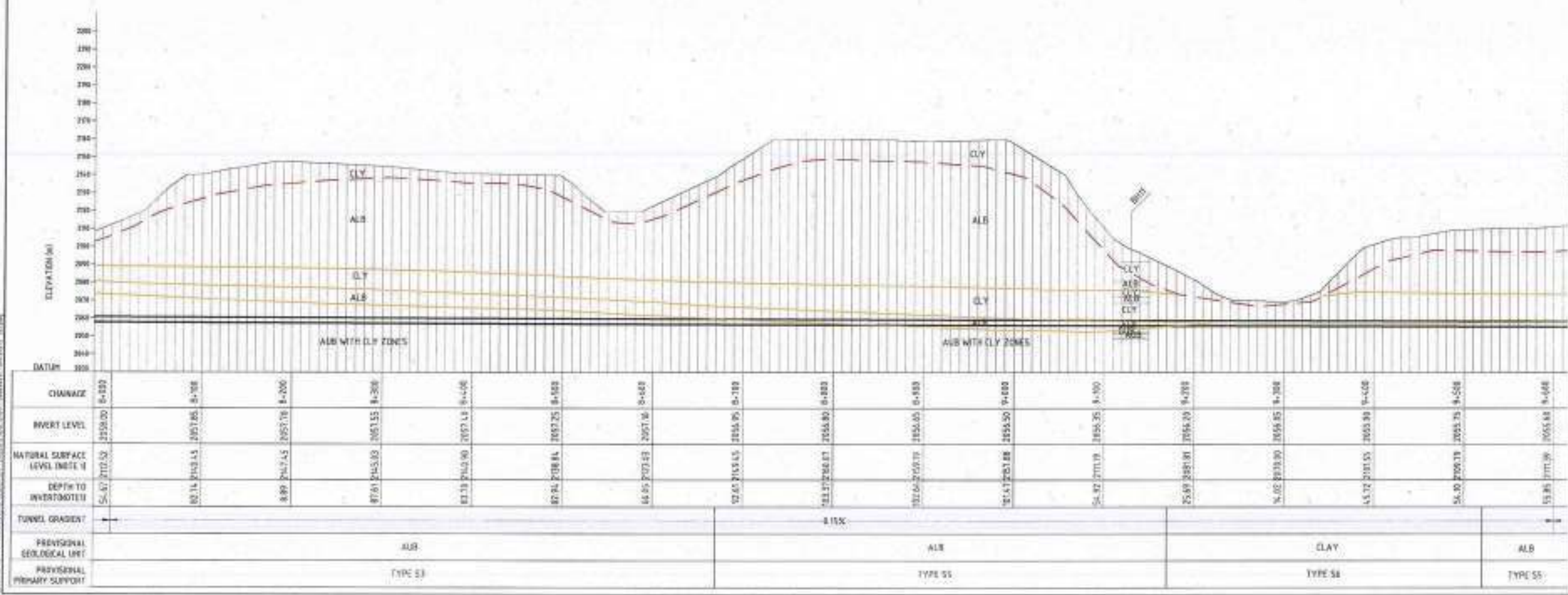
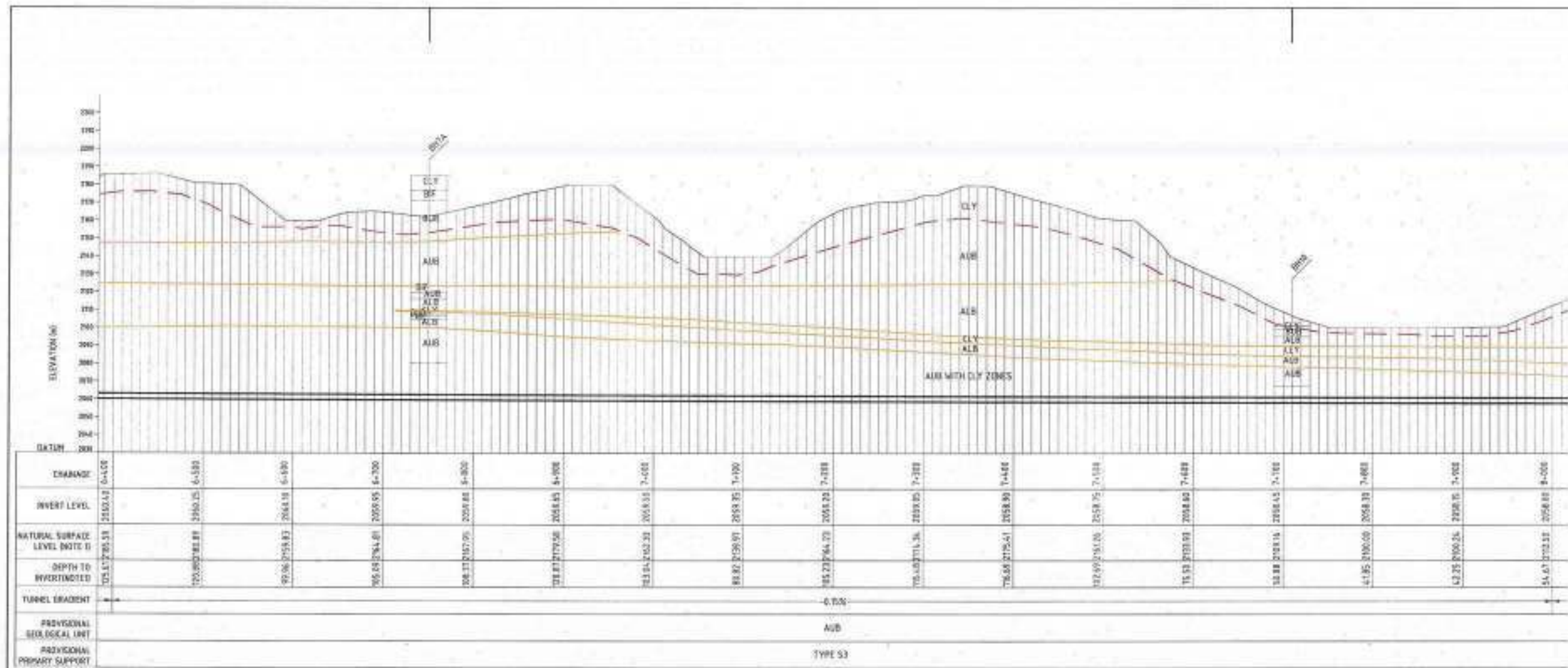
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Website: www.smc.com

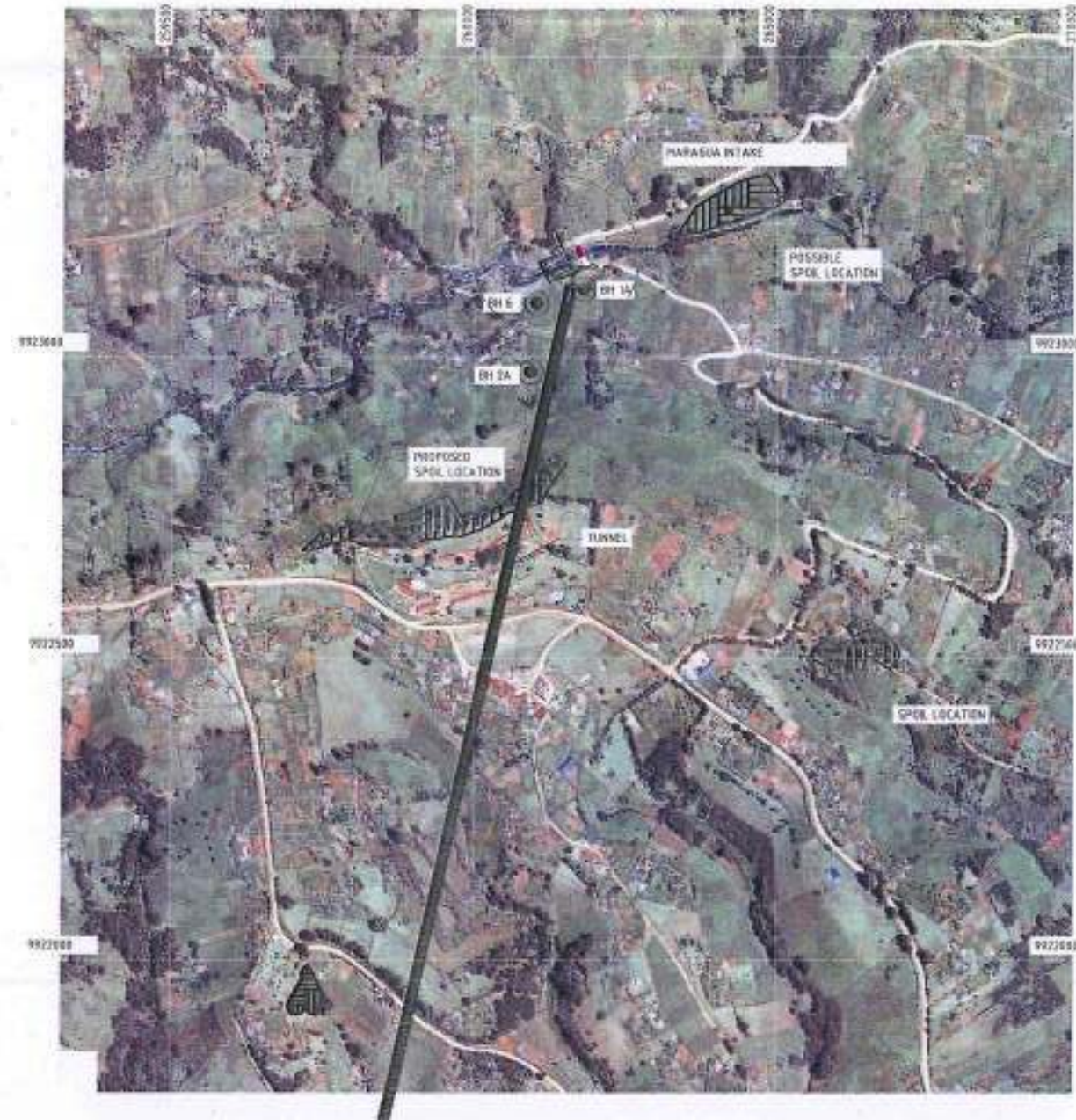
**NORTHERN COLLECTOR TUNNEL
PHASE 1**

Title: **MAIN TUNNEL
LONG SECTION
SHEET 3 OF 4**

| | | | |
|----------|--------------|------|------------|
| Drawn | R. BROWN | Date | 18.08.2013 |
| Designed | P. CORTESE | Date | 13.08.2013 |
| Checked | R. WOODROBEY | Date | 19.08.2013 |
| Approved | D. ROYAL | Date | 20.08.2013 |

| | | | |
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| Drawing No. | 5083023-TUN-01513 | Revision | B |
| Drawing Date | 18.08.2013 | Sheet Size | A1 |
| Drawing Status | TENDER | | |





MARAGUA AREA SITE MAP
SCALE (A1) 1:5,000

NOTES:

1. REFER TO DRAWING 00001 FOR LOCATION MAP
2. REFER TO DWG 00031A, 00032 FOR BOREHOLE COORDINATES

LEGEND

- SPOIL LOCATION
- BOREHOLE
- TUNNEL

NOTE:
SPOIL AND CAMP AREAS TO BE
CONFIRMED BY ATHI WATER



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| B | DRAFT TENDER | CHK | 05/11/2013 |
| A | FINAL DESIGN | CHK | 07/09/2012 |
| Rev | Revision | Approved | Date |

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| Drafting Check | Date |
| Civil Engineering Check | Date |

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**NORTHERN COLLECTOR TUNNEL
PHASE 1**

Title: **MARAGUA AREA
SITE MAP**

| | | | |
|----------|-----------|------|------------|
| Drawn | P. MURPHY | Date | 02/09/2013 |
| Designed | M. WYMER | Date | 02/09/2013 |
| Checked | R. MURPHY | Date | 05/09/2013 |
| Approved | D. SWING | Date | 06/09/2013 |

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|----------------|-------------------|------------|----|
| Drawing No. | 5093023-GEN-00041 | Revision | B |
| Drawing Scale | AS SHOWN | Sheet Size | A1 |
| Drawing Status | TENDER | | |

**TENDER DESIGN
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IRATI AREA SITE MAP
SCALE (A0) 1:5,000

NOTES:

1. REFER TO DRAWING 508321 FOR LOCATION MAP
2. REFER TO DWG 508324-04632 FOR BOREHOLE COORDINATES

LEGEND

- SPOIL/CAMP LOCATION
- BOREHOLE
- TUNNEL

NOTE:
SPOIL AND CAMP AREAS TO BE
CONFIRMED BY ATHI WATER

SCALE 1:5000

| Rev | Revision | Approved | Date |
|-----|--------------|----------|------------|
| B | DRAFT TENDER | D.K | 25.11.2012 |
| A | FIRST DRAFT | D.K | 27.09.2012 |

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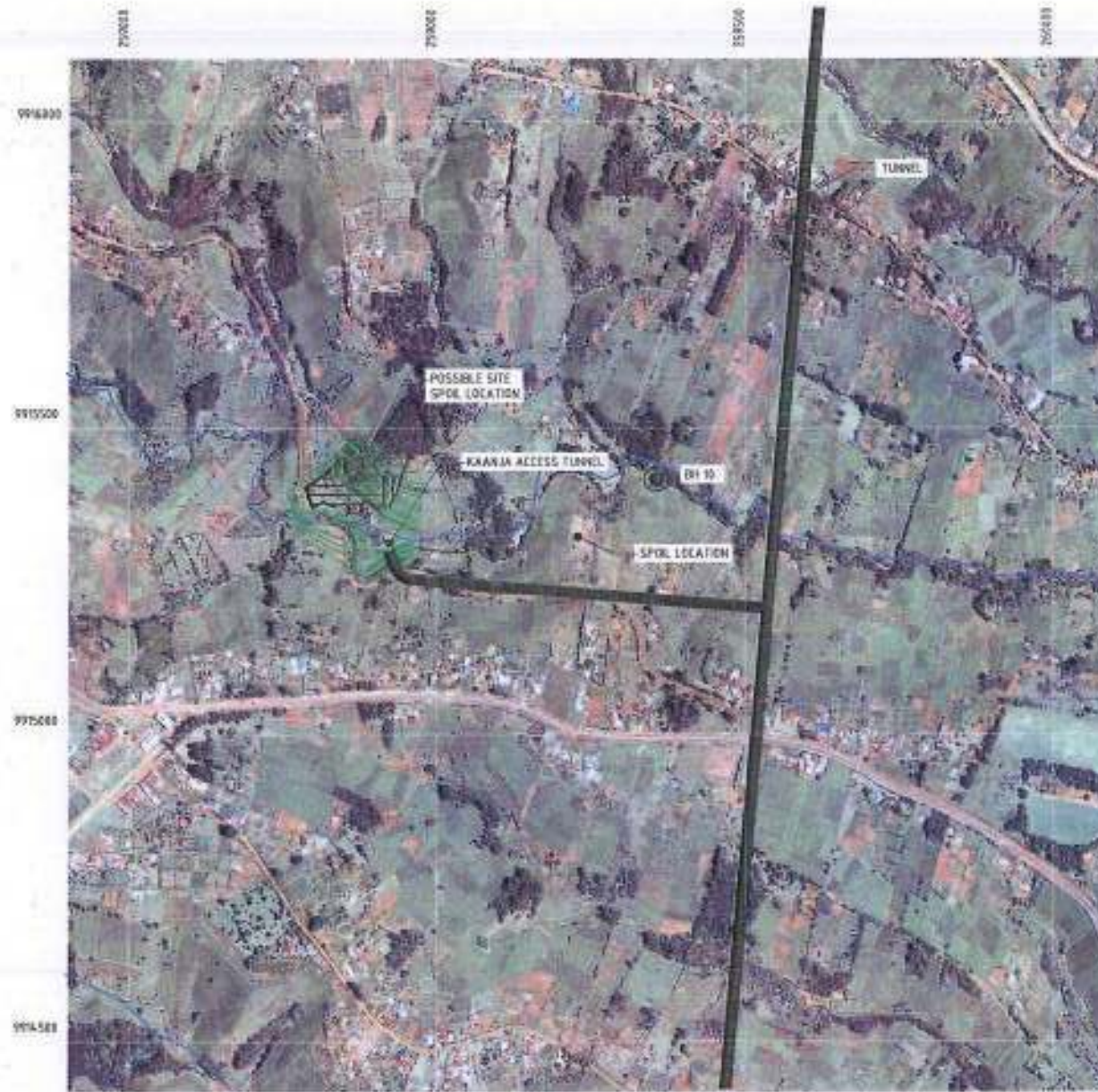
**NORTHERN COLLECTOR TUNNEL
PHASE 1**

Title: **IRATI AREA
SITE MAP**

| | |
|-----------------------|------------------|
| Drawn: F. MULWA | Date: 02.09.2012 |
| Designed: M. WANDIGA | Date: 02.09.2012 |
| Checked: R. NEYERCELT | Date: 05.09.2012 |
| Approved: D. BARRING | Date: 08.09.2012 |

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| Drawing No: 5083023-GEN-00043 | Revision: B |
| Drawing Date: AS SHOWN | Scale: Full |
| Drawing Status: TENDER | Sheet: A1 |

TENDER DESIGN
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KAANJA AREA SITE MAP
SCALE 1:15,000

NOTES:

- 1. REFER TO DRAWING 00021 FOR LOCATION MAP
- 2. REFER TO DWG 00031A 00032 FOR BOREHOLE COORDINATES

LEGEND

- SPOIL/CAMP LOCATION
- BOREHOLE
- TUNNEL

NOTE:
SPOIL AND CAMP AREAS TO BE
CONFIRMED BY ATHI WATER



| Rev | Revised | Revised | Date |
|-----|--------------|---------|------------|
| B | DRAFT TENDER | OK | 25.11.2013 |
| A | FIRST DRAFT | OK | 27.09.2013 |

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**NORTHERN COLLECTOR TUNNEL
PHASE 1**

Title: **KAANJA AREA
SITE MAP**

| | |
|------------------------|------------------|
| Drawn: P. MULLIWA | Date: 02.09.2013 |
| Designed: M. WINDIGISA | Date: 02.09.2013 |
| Checked: H. MUIRHEAD | Date: 02.09.2013 |
| Approved: D. KIRIMO | Date: 02.09.2013 |

| | |
|-------------------------------|----------------|
| Drawing No: 5083023-GEN-00044 | Revision: B |
| Drawing Scale: AS SHOWN | Sheet Size: A1 |
| Drawing Status: TENDER | |

**TENDER DESIGN
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GITHIKA AREA SITE MAP
SCALE 1:15,000

NOTES:

1. REFER TO DRAWING 00821 FOR LOCATION MAP
2. REFER TO DWG 00836-0012 FOR BOREHOLE COORDINATES

LEGEND

- SPOIL/CAMP LOCATION
- BOREHOLE
- TUNNEL

NOTE:
SPOIL AND CAMP AREAS TO BE
CONFIRMED BY ATHI WATER



| No. | Revision | Approved | Date |
|-----|----------|----------|------|
| 1 | | | |
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| CHECK PRINT | |
| Drawing Check | Date |
| Civil Engineering Check | Date |
| SMEC SMEC INTERNATIONAL PTY LTD Website: www.smec.com | |
| NORTHERN COLLECTOR TUNNEL PHASE 1 | |
| Title: GITHIKA AREA SITE MAP | |
| Drawn: F.MULWA | Date: 02.02.2013 |
| Designed: M.WANDIJA | Date: 02.02.2013 |
| Checked: R.MUNIRI | Date: 05.02.2013 |
| Approved: D.KIRANI | Date: 06.02.2013 |
| Drawing No: 5083023-GEN-00045 | Revision: B |
| Drawing Scale: AS SHOWN | Sheet Size: A1 |
| Drawing Status: TENDER | |

TENDER DESIGN
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**Appendix II: Species checklist of fish and aquatic macro-invertebrates of
NCT1 Rivers**

Appendix II-a Species checklist of fish and aquatic macro-invertebrates of NCT 1

| Order/classes | Family | Species | Common name | R. Githika | R. Irati | R. Gikigie | R. Maragua | Lower R. Maragua | Confluence Maragua a& Sagana | IUCN RED-LIST-conservation status | Micro-habitat P=Pool R=Riffle |
|---------------|------------|----------------|--------------------------------|-------------------------|----------|------------|------------|------------------|------------------------------|-----------------------------------|-------------------------------|
| 1 | Annelida | Hirudinae | <i>Hirudinae sp</i> | Leech | | | | 1 | | | P |
| 2 | Annelida | Oligochaetae | <i>Oligochaeta sp</i> | Aquatic earthworm | 1 | 1 | | 1 | | | P |
| 3 | Arachnida | Araninae | <i>Araninae sp</i> | spiders | 1 | 1 | | | | | P |
| 4 | Bivalvia | Sphaeriidae | <i>Pisidium sp</i> | Pill clam bivalves | 1 | 1 | 1 | | | | P |
| 5 | Coleoptera | Gyrinidae | <i>Aulonogyrus caffer</i> | whirligig beetles | 1 | 1 | 1 | 1 | 1 | NE | P |
| 6 | Coleoptera | Gyrinidae | <i>Aulonogyrus centralis</i> | whirligig beetles | 1 | 1 | 1 | | | NE | P |
| 7 | Coleoptera | Gyrinidae | <i>Aulonogyrus hypoxanthus</i> | whirligig beetles | 1 | | 1 | | | NE | P |
| 8 | Coleoptera | gyrinidae | <i>Dineutes sp</i> | whirligig beetles | 1 | 1 | | | | | P |
| 9 | Coleoptera | Dysticidae | <i>Dysticidae 1</i> | Predator divide beetles | | | 1 | | | | P |
| 10 | Coleoptera | Dysticidae | <i>Dysticidae 2</i> | Predator divide beetles | | | 1 | 1 | 1 | | P |
| 11 | Coleoptera | Elmidae | <i>Elmidae sp</i> | Riffle beetles | 1 | 1 | 1 | | | | R |
| 12 | Coleoptera | Helodidae | <i>Helodidae sp</i> | Marsh beetles | 1 | 1 | 1 | | | | P/R |
| 13 | Coleoptera | Hydraenidae | <i>Hydraenidae sp</i> | Minute moss beetles | | | | 1 | | | P |
| 14 | Coleoptera | Hydrophilidae | <i>Hydrophilidae sp</i> | Water scavenger beetles | | 1 | | 1 | | NE | R |
| 15 | Coleoptera | Gyrinidae | <i>Oreogyrus orientalis</i> | Whirligig beetles | 1 | | | 1 | | NE | P |
| 16 | Coleoptera | Dysticidae | <i>Yola tuberculata</i> | Predator divide beetles | 1 | | | | | | P |
| 17 | Coleoptera | Psephenidae | <i>Psephenus sp</i> | Water penny beetles | | | | 1 | | | R |
| 18 | Decapoda | Potamonautidae | <i>Potamonautes allusudi</i> | Freshwater crab | 1 | 1 | 1 | | | LC | P |

| | Order/class | Family | Species | Common name | R. Githik | R. Irati | R. Gikigle | R. Maragu | Lower R. Maragua | Confluence Maragu a& Sagana | IUCN RED-LIST- conserv ation status | Micro-habitat P=Pool R=Riffle |
|----|---------------|-----------------|------------------------------|---------------------|-----------|----------|------------|-----------|------------------|-----------------------------|-------------------------------------|-------------------------------|
| 19 | Decapoda | Potamonautidae | <i>Potamonautes odhneri</i> | Freshwater crab | 1 | 1 | 1 | 1 | 1 | 1 | LC | P |
| 20 | Diptera | Athericidae | <i>Athericidae sp</i> | Snipe flies | | | 1 | 1 | 1 | | | P |
| 21 | Diptera | Ceratopogonidae | <i>Ceratopogonidae sp</i> | Biting midges | 1 | 1 | 1 | | | | | P |
| 22 | Diptera | Chironomidae | <i>Chironomus sp</i> | midges | 1 | 1 | 1 | 1 | 1 | 1 | | P |
| 23 | Diptera | Simuliidae | <i>Simulium sp</i> | Black flies | 1 | 1 | 1 | 1 | 1 | 1 | | R |
| 24 | Diptera | Tipulidae | <i>Tipula sp</i> | Crane flies | 1 | 1 | 1 | | | | | R |
| 25 | Diptera | Tipulidae | <i>Tipulidae sp</i> | Crane flies | | 1 | 1 | | | | | R |
| 26 | Ephemeroptera | Heptageniidae | <i>Afronurus harrisoni</i> | Flatheaded mayflies | 1 | 1 | 1 | 1 | 1 | 1 | NE | R |
| 27 | Ephemeroptera | Baetidae | <i>Baetidae sp</i> | Minnow mayflies | 1 | 1 | 1 | 1 | 1 | 1 | | R |
| 28 | Ephemeroptera | Baetidae | <i>Baetis harrisoni</i> | Minnow mayflies | 1 | 1 | 1 | 1 | 1 | 1 | NE | R/P |
| 29 | Ephemeroptera | Caenidae | <i>Caenidae sp</i> | Cainflies -mayflies | 1 | 1 | | | 1 | | | P |
| 30 | Ephemeroptera | Leptophlebiidae | <i>Leptophlebiidae sp</i> | Pronggills mayflies | | 1 | | 1 | 1 | 1 | | P |
| 31 | Hemiptera | Geridae | <i>Eurymetra natalensis</i> | Pond skaters | 1 | | 1 | | | 1 | | P |
| 32 | Hemiptera | Hydrophilidae | <i>Helochares sp</i> | Water beetles | 1 | 1 | 1 | 1 | 1 | 1 | | P |
| 33 | Hemiptera | Nepidae | <i>Lacotrepes sp</i> | Water scorpion | 1 | | 1 | | | | | P |
| 34 | Hemiptera | Velidae | <i>Microvelia sp</i> | Water bugs | 1 | | 1 | | | | | P |
| 35 | Hemiptera | Cixiidae | <i>Sigara sp</i> | waterboatman | | | | 1 | | | | P |
| 36 | Hemiptera | Velidae | <i>Velidae sp</i> | | 1 | 1 | 1 | 1 | 1 | 1 | | P |
| 37 | Hemiptera | Naucoridae | <i>Laccocoris limigenus</i> | Reeping bugs | | | | | 1 | | | P |
| 38 | Hemiptera | Belastomatidae | <i>Sphaerodena nephoides</i> | Giant water bugs | | | | | 1 | 1 | | P |
| 39 | Hemiptera | Geridae | <i>Geridae sp</i> | Pond skaters | | | | | | 1 | | P |

| Order/class | Family | Species | Common name | R. Githika | R. Irati | R. Gikigle | R. Maragua | Lower R. Maragua | Confluence Maragua a& Sagana | IUCN RED-LIST- conservation status | Micro-habitat P=Pool R=Riffle |
|-------------|-------------|-------------------------------|----------------------------|------------|----------|------------|------------|------------------|------------------------------|------------------------------------|-------------------------------|
| 40 | Isopoda | Isopoda sp | Water lice | 1 | 1 | | 1 | | | | R/P |
| 41 | Lepidoptera | Pyralidae sp | moths | 1 | 1 | | | | | | R |
| 42 | Odonata | Aeshnidae sp | Dragon fly | 1 | | | | 1 | | | P |
| 43 | Odonata | Chlorocyphidae sp | Damselfly | 1 | 1 | | | 1 | | | R |
| 44 | Odonata | Chlorolestidae sp | Damselfly | | 1 | 1 | | | | | P |
| 45 | Odonata | Coenagrionidae sp | Damselfly | 1 | 1 | 1 | | 1 | | | P |
| 46 | Odonata | Corduliidae sp | Dragon fly | | | | | 1 | 1 | | P |
| 47 | Odonata | Gomphidae sp | Dragon fly | | | | 1 | | | | P |
| 48 | Odonata | Libellulidae flavescens | Dragon fly | 1 | | | | | | | P |
| 49 | Odonata | Libellulidae sp | Dragonfly | 1 | | 1 | 1 | 1 | | NE | P |
| 50 | Odonata | Coenagrionidae kerstleri | Damselfly | 1 | | | | 1 | | Ne | P/R |
| 51 | Odonata | Coenagrionidae africalagma | Damselfly | | | | | 1 | | NE | R/P |
| 52 | Odonata | Chlorocyphidae caligata | Damselfly | | | | | 1 | | NE | P |
| 53 | Pisces/Fish | Amphiliidae uranoscopus | Stargazer mountain catfish | 1 | 1 | 1 | 1 | | | LC | R |
| 54 | Pisces/Fish | Cyprinidae Barbus oxyrinchus | Pangani Barb fish | | | | | | 1 | LC | R |
| 55 | Pisces/Fish | Cyprinidae Barbus paludinosus | Barb fish | | | | | | 1 | LC | P |
| 56 | Pisces/Fish | Cyprinidae Barbus sp | Barb fish | | | | | | 1 | LC | P |
| 57 | Pisces/Fish | Cyprinidae Labeo cylindricus | Redeye Labeo fish | | | | | 1 | | LC | P |
| 58 | Pisces/Fish | Cichlidae Oreochromis sp | Athi ilapia | | | | | | 1 | NE | P |
| 59 | Pisces/Fish | Cyprinidae Garra dembenensis | Dembea stone lapper | | | 1 | | | | NE | R |
| 60 | Platyhelmin | Turbellaria Turbellaria sp | Flatworm | | 1 | | 1 | 1 | 1 | | R |

| Order/class | Family | Species | Common name | R. Githika | R. Irati | R. Gikigie | R. Maragua | Lower R. Maragua | Confluence Maragua & Sagana | IUCN RED-LIST-conservation status | Micro-habitat P=Pool R=Riffle |
|-------------|-------------|-----------------|----------------------------------|------------|----------|------------|------------|------------------|-----------------------------|-----------------------------------|-------------------------------|
| 61 | Plecoptera | Perlidae | <i>Neoperla</i> sp | | 1 | 1 | 1 | 1 | | | R |
| 62 | Trichoptera | Hydropsychidae | <i>Aethaloptera maxima</i> | | 1 | 1 | | 1 | | NE | R |
| 63 | Trichoptera | Hydropsychidae | <i>Aethaloptera</i> sp | | 1 | 1 | | | | | R |
| 64 | Trichoptera | Brachycentridae | <i>Brachycentridae</i> sp | | | | 1 | | | | R |
| 65 | Trichoptera | Hydropsychidae | <i>Cheumatopsyche</i> sp | | 1 | | | 1 | | | R/P |
| 66 | Trichoptera | Hydropsychidae | <i>Cheumatopsyche thomasetti</i> | | 1 | 1 | | | | NE | R/P |
| 67 | Trichoptera | Ecnomidae | <i>Ecnomidae</i> sp | | 1 | 1 | 1 | 1 | | | R |
| 68 | Trichoptera | Hydropsychidae | <i>Hydropsyche</i> sp | 1 | 1 | 1 | 1 | 1 | | | R |
| 69 | Trichoptera | Hydropsychidae | <i>Hydropsychidae</i> sp | | 1 | 1 | | 1 | | | R |
| 70 | Trichoptera | Leptoceridae | <i>Leptoceridae</i> sp | | | | | | 1 | | P |
| 71 | Trichoptera | Ecnomidae | <i>Parecnomina</i> sp | 1 | 1 | 1 | 1 | | | | R |
| 72 | Trichoptera | Teloganodidae | <i>Teloganodidae</i> sp | 1 | | 1 | | | | | R |
| 73 | Trichoptera | Tricorythidae | <i>Tricorythidae</i> sp | 1 | | | | 1 | | | R |
| 74 | Amphibia | Anura | <i>Anura</i> sp | 1 | | 1 | 1 | | 1 | | P |
| 75 | Reptilia | Corubridae | <i>Corubridae</i> sp | | | | | | 1 | | T |
| 76 | Carnivora | Mustelidae | <i>Aonyx capensis</i> | 1 | | 1 | | | | NE | T |
| 77 | Hemiptera | Corixidae | <i>Micronecta</i> sp | | | 1 | | | | | P |

Appendix II-b Bird species checklist

| Scientific name | Common name | R. Githika | R. Irati | R. Gikigie | R. Maragua | Lower R. Maragua | Confluence Maragua & Sagana | IUCN RED-list- conservation status Key: NE=Not Evaluated LC=Least Concern |
|------------------------------|---------------------------------|------------|----------|------------|------------|------------------|-----------------------------|--|
| 1 <i>Nectarinia sp</i> | Eastern double Collared sunbird | | 1 | 1 | | | | |
| 2 <i>Pycnonotus barbatus</i> | Common bulbul | 1 | 1 | 1 | | 1 | 1 | LC |
| 3 <i>Estrilda astrild</i> | Common waxbill | 1 | 1 | 1 | | | | LC |
| 4 <i>Ceryle rudis</i> | Pied Kingfisher | | | | | | 1 | LC |
| 5 <i>Bubulcus ibis</i> | Cattle egret | | | | | | 1 | LC |
| 6 <i>Ploceus sp</i> | Weaver bird | 1 | 1 | 1 | | | | |
| 7 <i>Saxicola torquatus</i> | Common stonechat bird | | 1 | 1 | | | | LC |
| 8 <i>Alcedo cristata</i> | Malachite kingfisher | | | | | | 1 | LC |

Appendix III: Species Checklist of Plants of NCT1

Checklist of plants within NCT1 Project area

T= Tree, H= Herb, S= Shrub, C= Climber, In= Invasive, We= Weed, Hy= Hydrophyte, Hw= Highly water dependent, Id= Indicator of disturbance, In= Invasive, Ex= exotic

| Family | Species | LF | R. Gikigie | R. Githaga | R. Irati | R. Maragua | Confluence | Lower Maragua | Description |
|----------------|--|----|------------|------------|----------|------------|------------|---------------|-------------|
| Acanthaceae | <i>Barleria submolis</i> Lindau | H | | | | | 1 | 1 | |
| Acanthaceae | <i>Dyschonia hildebrandii</i> Lindau ex Engl. | H | | | | | | 1 | |
| Acanthaceae | <i>Hypoestes aristata</i> (Vahl) Roem. & Schult. | H | | 1 | | | | | HW |
| Acanthaceae | <i>Hypoestes forskalii</i> (Vahl) R.Br. | H | | | | 1 | | | |
| Acanthaceae | <i>Justicia</i> sp. | H | | | | | | 1 | |
| Acanthaceae | <i>Phaulopsis imbricata</i> (Forsk.) Sweet | H | | 1 | | | | | Hw |
| Acanthaceae | <i>Ruellia patula</i> Jacq. | H | | | | 1 | | | |
| Amaranthaceae | <i>Achyranthes aspera</i> L. | H | 1 | 1 | 1 | 1 | 1 | | We, Id |
| Amaranthaceae | <i>Alternanthera pungens</i> Kunth | H | | | | | 1 | | We |
| Amaranthaceae | <i>Alternanthera sessilis</i> (L.) DC. | H | | | | | 1 | | Hy |
| Amaranthaceae | <i>Amaranthus graecizans</i> L. | H | | | | | 1 | | We, Id |
| Amaranthaceae | <i>Amaranthus hybridus</i> L. | H | | | | | 1 | | We, Id |
| Amaranthaceae | <i>Purulia lappacea</i> (L.) A. Juss. | H | | | | 1 | 1 | | |
| Amaryllidaceae | <i>Scadoxus multiflorus</i> (Martyn) Raf. | H | 1 | | | | | | |
| Anacardiaceae | <i>Mangifera indica</i> L. | T | | | | | 1 | | |
| Anacardiaceae | <i>Rhus longipes</i> Engl. | T | | | | | | 1 | |
| Anacardiaceae | <i>Rhus natalensis</i> Krauss | T | | | | | | | |
| Apocynaceae | <i>Tabernaemontana stapfiana</i> Britton | T | 1 | | | | | 1 | |
| Araceae | <i>Ansaema mildbraedii</i> Engl. | H | 1 | | | | | | |
| Araceae | <i>Colocasia esculenta</i> (L.) Schott | H | 1 | 1 | 1 | 1 | | | Hy |
| Araliaceae | <i>Polyscias likuyensis</i> Summerh. | T | | 1 | | | | | |
| Asclepiadaceae | <i>Mondia whitei</i> (Hook.f.) Skeels | C | | | | 1 | | | |
| Asparagaceae | <i>Asparagus racemosus</i> Willd. | S | 1 | | 1 | 1 | | | |
| Aspleniaceae | <i>Asplenium aethiopicum</i> (Burm.f.) Bech. | H | | | 1 | | | | |
| Aspleniaceae | <i>Asplenium friesorum</i> C. Chr. | H | | | | | 1 | | |
| Balsaminaceae | <i>Impatiens hochstetteri</i> Warb. | H | | 1 | 1 | 1 | | | HW |
| Balsaminaceae | <i>Impatiens</i> sp. | H | 1 | 1 | 1 | 1 | | | HW |
| Basellaceae | <i>Basella alba</i> L. | C | | 1 | | | | | HW |
| Begoniaceae | <i>Begonia meyeri-johannis</i> Engl. | C | 1 | | 1 | 1 | | | HW |
| Bignoniaceae | <i>Spathodes campanulata</i> P. Beauv. | T | | | | | 1 | | HW |
| Boraginaceae | <i>Heliotropium steudneri</i> Vaitke | H | | | | | 1 | | Id |

| Family | Species | LF | R. Gikigie | R. Githaga | R. Irati | R. Maragua | Confluence | Lower Maragua | Description |
|-----------------|--|----|------------|------------|----------|------------|------------|---------------|-------------|
| Caesalpinaceae | <i>Bauhinia tomentosa</i> L. | T | | | | | | 1 | |
| Caesalpinaceae | <i>Caesalpinia volkensii</i> Harms | C | | | | | 1 | | |
| Caesalpinaceae | <i>Pithecolobium thoningii</i> (Schumacher) Milne-Recht. | T | | | | | | 1 | |
| Caesalpinaceae | <i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby | T | | | | | 1 | 1 | |
| Caesalpinaceae | <i>Senna occidentalis</i> L. | S | | | | | 1 | 1 | |
| Caesalpinaceae | <i>Senna siamea</i> (Lam.) Irwin et Barneby | T | | | | | 1 | 1 | |
| Caesalpinaceae | <i>Senna singuana</i> (Delile) Lock | T | | | | | 1 | 1 | |
| Caryophyllaceae | <i>Drymaria cordata</i> (L.) Willd. ex Roem. & Schult. | H | 1 | 1 | 1 | 1 | | | HW |
| Casuarinaceae | <i>Casuarina equisetifolia</i> L. | T | | 1 | | | | | |
| Celastraceae | <i>Maytenus heterophylla</i> (Eckl. & Zeyh.) N. Robson | T | | | | | | 1 | |
| Chenopodiaceae | <i>Chenopodium ambrosioides</i> L. | H | | | | | 1 | | We, Id |
| Commelinaceae | <i>Commelina benghalensis</i> L. | H | 1 | 1 | 1 | 1 | 1 | 1 | We, Id |
| Commelinaceae | <i>Commelina diffusa</i> Burm. f. | H | | | | | 1 | 1 | Hy |
| Commelinaceae | <i>Commelina latifolia</i> A. Rich. | H | 1 | 1 | 1 | 1 | | | |
| Commelinaceae | <i>Commelina</i> sp. | H | | 1 | 1 | 1 | | | |
| Compositae | <i>Acmelia calirrhiza</i> Delile | H | 1 | 1 | 1 | 1 | 1 | 1 | HW |
| Compositae | <i>Ageratum conyzoides</i> L. | H | 1 | 1 | 1 | 1 | 1 | 1 | |
| Compositae | <i>Alemnisia</i> sp. | S | | | | | 1 | 1 | We, Id |
| Compositae | <i>Aspilia mossambicensis</i> (Oliv.) Wild | H | | | | | 1 | 1 | We, Id |
| Compositae | <i>Bidens biternata</i> (Lour.) Merr. & Sherff | H | | | | | 1 | 1 | |
| Compositae | <i>Bidens pilosa</i> L. | H | 1 | 1 | 1 | 1 | 1 | 1 | We, Id |
| Compositae | <i>Carduus chamaecephalus</i> (Vatke) Oliv. & Hiern | H | | | | | 1 | | |
| Compositae | <i>Coryza bonariensis</i> (L.) Cronquist | H | 1 | 1 | 1 | 1 | 1 | 1 | |
| Compositae | <i>Coryza pallidiflora</i> R.E.Fr. | H | | | | | 1 | | |
| Compositae | <i>Coryza subscaposa</i> O. Hoffm. | H | | | | | 1 | | |
| Compositae | <i>Crassocephalum montuosum</i> (S. Moore) Milne-Recht. | H | 1 | 1 | 1 | 1 | 1 | 1 | |
| Compositae | <i>Crassocephalum x picridifolium</i> (DC.) S. Moore | H | 1 | 1 | 1 | 1 | 1 | 1 | |
| Compositae | <i>Dichrocephala integrifolia</i> (L.f.) Kuntze | H | | | | | 1 | | We, Id |
| Compositae | <i>Echinops gracilis</i> O. Hoffm. | H | | | | | 1 | | |
| Compositae | <i>Galinops parviflora</i> Cav. | H | | 1 | 1 | 1 | 1 | 1 | |
| Compositae | <i>Gutierrezia coratolia</i> Benth. ex Oliv. | H | | | | | | 1 | |
| Compositae | <i>Helichrysum schimperii</i> (Sch. Bip.) Moeaser | H | | | | | 1 | 1 | |
| Compositae | <i>Helichrysum</i> sp. | H | | 1 | 1 | 1 | 1 | 1 | |

| Family | Species | LF | R. Gikigie | R. Githaga | R. Irati | R. Maragua | Confluence | Lower Maragua | Description |
|------------------|---|----|------------|------------|----------|------------|------------|---------------|-------------|
| Compositae | <i>Leggiera brevipes</i> Oliv. & Hiern | H | | 1 | | | | 1 | |
| Compositae | <i>Launaea comuta</i> (Hochst. ex Oliv. & Hiern) C. Jeffrey | H | | 1 | | 1 | 1 | | We. Id |
| Compositae | <i>Microglossa densiflora</i> Hook.f. | S | 1 | 1 | 1 | | | | |
| Compositae | <i>Mikania chenopodiifolia</i> Wild. | C | 1 | | 1 | | | | Hy |
| Compositae | <i>Pseudognaphalium luteo-album</i> (L.) Hilliard & B.L. Burt | H | | 1 | | 1 | 1 | | |
| Compositae | <i>Solanecio mannii</i> (Hook.f.) C. Jeffrey | T | 1 | 1 | | | | | HW |
| Compositae | <i>Sonchus oleraceus</i> L. | H | | | | 1 | | | |
| Compositae | <i>Sphaeranthus suaveolens</i> (Forsk.) DC. | H | 1 | | 1 | | 1 | | Hy |
| Compositae | <i>Tagetes minuta</i> L. | H | | 1 | | | 1 | 1 | We. Id |
| Compositae | <i>Tithonia diversifolia</i> (Hemsl.) A. Gray | S | | | | | 1 | 1 | Id |
| Compositae | <i>Tridax procumbens</i> L. | H | | | | | | 1 | Id |
| Compositae | <i>Vernonia auncullifera</i> Hiern | S | | 1 | 1 | | | | |
| Compositae | <i>Vernonia galamensis</i> (Cass.) Less. | H | 1 | | | 1 | | | |
| Compositae | <i>Vernonia lasiopus</i> O. Hoffm. | S | | | 1 | | | 1 | Id |
| Compositae | <i>Vernonia</i> sp. | H | | | | | | 1 | |
| Convolvulaceae | <i>Ipomoea cainica</i> (L.) Sweet | C | | | | | 1 | | |
| Crassulaceae | <i>Crassula volkensii</i> Engl. | H | | 1 | | 1 | | | HW |
| Crassulaceae | <i>Kalanchoe densiflora</i> Rottf. | H | 1 | 1 | | | | | |
| Cucurbitaceae | <i>Legenaria abyssinica</i> (Hook.f.) C. Jeffrey | C | 1 | | | 1 | | | HW |
| Cucurbitaceae | <i>Momordica foetida</i> Schumacher | C | 1 | | | 1 | | | |
| Cucurbitaceae | <i>Momordica hirsutum</i> (Harms) C. Jeffrey | C | 1 | 1 | | | | | |
| Cucurbitaceae | <i>Oreosyce africana</i> Hook.f. | C | 1 | | | 1 | | | |
| Cucurbitaceae | <i>Zehneria scabra</i> (L.f.) Sond. | C | 1 | 1 | | | | | Id |
| Cupressaceae | <i>Cupressus lusitanica</i> L. | T | | 1 | | 1 | | | Ex |
| Cyatheaceae | <i>Cyathea manniana</i> Hook. | T | 1 | 1 | | | | | |
| Cyperaceae | <i>Cyperus ejax</i> C.B. Clarke | H | | 1 | | | | | |
| Cyperaceae | <i>Cyperus difformis</i> L. | H | | | | | 1 | | Hy |
| Cyperaceae | <i>Cyperus distans</i> L.f. | H | 1 | 1 | | 1 | | | |
| Cyperaceae | <i>Cyperus dubius</i> Rottb. | H | | | | 1 | | | |
| Cyperaceae | <i>Cyperus glaucophyllus</i> Boeck. | H | | | | 1 | | | |
| Cyperaceae | <i>Cyperus schimperianus</i> Steud. | H | | | | | 1 | | |
| Cyperaceae | <i>Cyperus</i> sp. | H | | 1 | | | | 1 | Hy |
| Cyperaceae | <i>Cyperus tomanophyllus</i> K. Schum. | H | | | | | | | |
| Cyperaceae | <i>Fimbristylis complanata</i> (Retz.) Link | H | | | | | | 1 | Hy |
| Cyperaceae | <i>Kyllinga comosipes</i> (Maltf. & Kuhn) Napper | H | | | | | | 1 | |
| Cyperaceae | <i>Kyllinga odorata</i> Vahl | H | | 1 | | | | | HW |
| Cyperaceae | <i>Pycurus sanguinolentus</i> (Vahl) Nees | H | | | | | | 1 | |
| Dennstaedtiaceae | <i>Pteridium aquilinum</i> (L.) Kuhn | H | 1 | 1 | | 1 | | 1 | Id |

| Family | Species | LF | R. Gikigie | R. Githaga | R. Irati | R. Maragua | Confluence | Lower Maragua | Description |
|-----------------|---|----|------------|------------|----------|------------|------------|---------------|-------------|
| Dracaenaceae | <i>Dracaena afrontomontana</i> Mitobr. | S | | | | 1 | | | |
| Dracaenaceae | <i>Dracaena steudneri</i> Engl. | T | | 1 | | | | | |
| Dryopteridaceae | <i>Polystichum</i> sp. | H | | 1 | | | | | |
| Ebenaceae | <i>Euclea divinorum</i> Hiern | T | | | | | | 1 | |
| Euphorbiaceae | <i>Acalypha racemosa</i> Baill. | S | 1 | | | 1 | | | |
| Euphorbiaceae | <i>Bridelia micrantha</i> (Hochst.) Baill. | T | | | | 1 | 1 | | |
| Euphorbiaceae | <i>Croton macrostachyus</i> Delle | T | | 1 | | 1 | | | |
| Euphorbiaceae | <i>Euphorbia hirta</i> L. | H | | | | | 1 | | Id |
| Euphorbiaceae | <i>Macaranga kii-mandschanica</i> Pax | T | 1 | 1 | 1 | 1 | | | |
| Euphorbiaceae | <i>Neoboutonia macrocalyx</i> Pax | T | | 1 | | 1 | | | |
| Euphorbiaceae | <i>Phyllanthus amarus</i> Schumacher & Thonn. | H | 1 | 1 | 1 | 1 | | 1 | |
| Euphorbiaceae | <i>Phyllanthus fischeri</i> Pax | S | | | | | 1 | | |
| Euphorbiaceae | <i>Ricinus communis</i> L. | S | | | | | 1 | | Id |
| Flacourtiaceae | <i>Casearia baillacombetii</i> R.E. Fr. | T | | 1 | | | | | |
| Flacourtiaceae | <i>Dovyalis abyssinica</i> (A. Rich.) Warb. | T | | 1 | 1 | | | | |
| Geraniaceae | <i>Geranium arabicum</i> (A. Rich.) Kokwaro | H | | 1 | 1 | 1 | | | |
| Gesneriaceae | <i>Streptocarpus glandulosissimus</i> Engl. | H | | | | 1 | | | |
| Gramineae | <i>Agrostis</i> sp. | H | 1 | | | | | | |
| Gramineae | <i>Bambusa</i> sp. | T | | | | 1 | | | |
| Gramineae | <i>Cynodon nlemfuenensis</i> Vanderyst | H | | | | | 1 | | |
| Gramineae | <i>Dactyloctenium</i> sp. | H | | | | | 1 | | |
| Gramineae | <i>Digitaria abyssinica</i> (A. Rich.) Stapf | H | | 1 | 1 | 1 | | | |
| Gramineae | <i>Digitaria</i> sp. | H | | | 1 | | | | Id |
| Gramineae | <i>Digitaria velutina</i> (Forsk.) P. Beauv. | H | | 1 | 1 | | | | Hy |
| Gramineae | <i>Echinochloa colona</i> (L.) Link | H | | | | | 1 | | |
| Gramineae | <i>Eleusine jaegeri</i> Pilg. | H | | | | | 1 | | |
| Gramineae | <i>Eragrostis schweinfurthii</i> Chiov. | H | | | | | | 1 | |
| Gramineae | <i>Hyparrhenia filipendula</i> (Hochst.) Stapf | H | | | | | | 1 | |
| Gramineae | <i>Isachne mauritiana</i> Kunth | H | 1 | | | | | | |
| Gramineae | <i>Optisemenus hirtellus</i> (L.) P. Beauv. | H | | | | | | 1 | |
| Gramineae | <i>Panicum calvum</i> Stapf | H | 1 | 1 | 1 | 1 | | | HW |
| Gramineae | <i>Panicum</i> sp. | H | 1 | | | | | | |
| Gramineae | <i>Panicum trichocladum</i> K. Schum. | H | | | | | | 1 | |
| Gramineae | <i>Paspalum scrobiculatum</i> L. | H | | | 1 | | | | |
| Gramineae | <i>Pennisetum purpureum</i> Schumacher | H | 1 | 1 | 1 | 1 | | 1 | |
| Gramineae | <i>Setaria plicatilis</i> (Hochst.) Engl. | H | 1 | 1 | 1 | 1 | | | |
| Gramineae | <i>Sinarundinaria alpina</i> (K. Schum.) C.S. Chao & Renvoize | T | 1 | 1 | 1 | 1 | | | |
| Gramineae | <i>Sporobolus pyramidalis</i> P. Beauv. | H | | | | | | 1 | |
| Gramineae | <i>Sporobolus</i> sp. | H | | | | | 1 | | |

| Family | Species | LF | R. Gikigie | R. Githaga | R. Irati | R. Maragua | Confluence | Lower Maragua | Description |
|-----------------|--|----|------------|------------|----------|------------|------------|---------------|-------------|
| Guttiferae | <i>Hybanum revolutum</i> Vahl | T | | 1 | | | | | |
| Icecinaceae | <i>Apodytes dimidiata</i> Am. | T | | | 1 | 1 | | | |
| Labiatae | <i>Achyropernum schimperii</i> (Briq.) Perkins | H | | 1 | | 1 | | | |
| Labiatae | <i>Clinopodium abyssinicum</i> (Benth) Kuntze | H | 1 | | | 1 | | | |
| Labiatae | <i>Hypsis suaveolens</i> Poit. | H | | | | | 1 | 1 | Id |
| Labiatae | <i>Leonotis nepetifolia</i> (L.) R.Br. | H | | | 1 | | | | Id |
| Labiatae | <i>Leucas grandis</i> Vaitke | H | | 1 | | | | | |
| Labiatae | <i>Ocimum gratissimum</i> Forsk. | S | | | | | | 1 | Id |
| Labiatae | <i>Plectranthus barbatus</i> Sims | S | | | 1 | 1 | 1 | 1 | |
| Labiatae | <i>Plectranthus hamerunensis</i> Guentke | C | | 1 | | 1 | | | |
| Labiatae | <i>Plectranthus laxiflorus</i> Benth. | S | 1 | 1 | 1 | 1 | | | |
| Labiatae | <i>Plectranthus sp.</i> | H | 1 | 1 | 1 | 1 | | 1 | |
| Lauraceae | <i>Persea americana</i> Mill. | T | 1 | | 1 | 1 | | | |
| Lobeliaceae | <i>Lobelia gibberoa</i> Hemsl. | S | | 1 | 1 | 1 | | | |
| Lobeliaceae | <i>Monopsis stellanoides</i> (C.Presl) Urb. | H | 1 | 1 | 1 | 1 | | | Hy |
| Loganiaceae | <i>Nuxia congesta</i> Fresen. | T | 1 | | 1 | 1 | | | |
| Lycopodiaceae | <i>Lycopodium clavatum</i> L. | H | | | | 1 | | | HW |
| Lythraceae | <i>Lewsonia inermis</i> L. | S | | | | | 1 | | HW |
| Malvaceae | <i>Hibiscus acetosella</i> | S | | 1 | 1 | | | | in. Id |
| Malvaceae | <i>Hibiscus diversifolius</i> Jacq. | S | | 1 | | 1 | 1 | 1 | |
| Malvaceae | <i>Hibiscus macranthus</i> A.Rich. | S | | | | | 1 | | |
| Malvaceae | <i>Hibiscus sp.</i> | H | | 1 | | | | | |
| Malvaceae | <i>Pavonia urens</i> Cav. | S | | 1 | | 1 | | | |
| Malvaceae | <i>Sida ovalis</i> Forssk. | S | | | | 1 | 1 | | |
| Malvaceae | <i>Sida tenuicarpa</i> Vollesen | S | | | | | 1 | 1 | |
| Malvaceae | <i>Sida viridiflora</i> (L.) D. Don | S | 1 | | 1 | 1 | | | Ex. In |
| Melastomataceae | <i>Clerodermis hirta</i> (L.) D. Don | T | | | 1 | | | | |
| Melastomataceae | <i>Bersama abyssinica</i> Fresen. | T | | | 1 | | | | |
| Mimosaceae | <i>Acacia mearnsii</i> De Wild. | T | 1 | 1 | 1 | 1 | | | Ex |
| Mimosaceae | <i>Albizia gummifera</i> (J.F. Gmel.) C.A. Sm. | T | | | | 1 | | | |
| Mimosaceae | <i>Dichrostachys cinerea</i> (L.) Wight & Arn. | T | | | | | 1 | | |
| Mimosaceae | <i>Mimosa pudica</i> L. | H | | | | | 1 | | |
| Monimiaceae | <i>Xymalos monospora</i> (Harv.) Warb. | T | 1 | 1 | 1 | 1 | | | |
| Moraceae | <i>Ficus exasperata</i> Vahl | T | | | | | 1 | | |
| Moraceae | <i>Ficus glumosa</i> Dettle | T | | | 1 | | | | HW |
| Moraceae | <i>Ficus lutea</i> Vahl | T | | | | | | 1 | HW |
| Moraceae | <i>Ficus sur</i> Forssk. | T | | | | | | 1 | HW |
| Moraceae | <i>Ficus sycamorus</i> L. | T | | | | | | 1 | HW |
| Moraceae | <i>Ficus thoningii</i> Blume | T | | | 1 | 1 | 1 | 1 | |
| Moraceae | <i>Ficus vallis-choudae</i> Dettle | T | | | | | | 1 | HW |
| Myrsinaceae | <i>Embelia schimperii</i> Vaitke | S | 1 | | 1 | 1 | | | HW |

| Family | Species | LF | R. Gikigie | R. Githaga | R. Irati | R. Maragua | Confluence | Lower Maragua | Description |
|----------------|---|----|------------|------------|----------|------------|------------|---------------|-------------|
| Myrsinaceae | <i>Maesa lanceolata</i> Forsk. | T | 1 | 1 | 1 | 1 | | | |
| Myrsinaceae | <i>Rapanea melanophloea</i> (L.) Mez | T | 1 | | 1 | 1 | | | |
| Myrtaceae | <i>Eucalyptus</i> sp. | T | | 1 | 1 | 1 | 1 | 1 | Id |
| Myrtaceae | <i>Psidium guajava</i> L. | T | | | | | | 1 | HW |
| Myrtaceae | <i>Syzygium cordatum</i> Hochst. | T | | | | | | 1 | HW |
| Myrtaceae | <i>Syzygium guineense</i> (Wild.) DC. | T | | | 1 | 1 | | | HW |
| Oleaceae | <i>Strombosia schefferi</i> Engl | T | | | 1 | | | | |
| Oleaceae | <i>Jasminum floribundum</i> Fres. | C | | | 1 | | | | |
| Oleaceae | <i>Jasminum fluminense</i> | C | | | | | | 1 | |
| Onagraceae | <i>Ludwigia abyssinica</i> A. Rich | H | | 1 | | | 1 | 1 | Hy |
| Onagraceae | <i>Ludwigia stenographa</i> (Brenan) Hare | H | | | | | 1 | | Hy |
| Orchidaceae | <i>Aerangis thomsonii</i> (Rolfe) Schltr. | H | | | 1 | | | | HW |
| Orchidaceae | <i>Polystachya</i> sp. | H | | | | 1 | | | HW |
| Oxalidaceae | <i>Oxalis corniculata</i> L. | H | | | | 1 | | 1 | We. Id |
| Oxalidaceae | <i>Oxalis latifolia</i> Kunth | H | 1 | 1 | 1 | 1 | | | Id |
| Papilionaceae | <i>Amphicarpa africana</i> (Hook.f.) Harms | H | | 1 | | | | | |
| Papilionaceae | <i>Crotalaria agatiflora</i> Schweinf. | T | 1 | 1 | 1 | 1 | | | Id |
| Papilionaceae | <i>Crotalaria axillaris</i> Aiton | S | | | | | | 1 | |
| Papilionaceae | <i>Crotalaria goodii</i> Vaitke | S | | 1 | | | | 1 | |
| Papilionaceae | <i>Delbergia lactea</i> Vaitke | S | | | | 1 | | | |
| Papilionaceae | <i>Desmodium repandum</i> (Vahl) DC. | H | | | | 1 | | | |
| Papilionaceae | <i>Desmodium sandwicense</i> E. Mey | H | | | | | | 1 | Id |
| Papilionaceae | <i>Glycine wightii</i> (Wight & Arn.) Verdc. | C | | | | 1 | 1 | 1 | |
| Papilionaceae | <i>Indigofera arrecta</i> A. Rich. | S | | | | | | 1 | |
| Papilionaceae | <i>Pseudarthria hookeri</i> Wight & Arn. | S | | | | | | 1 | |
| Papilionaceae | <i>Rhynchosia minima</i> (L.) DC. | C | | 1 | 1 | 1 | | | Id |
| Papilionaceae | <i>Sesbania sesban</i> (L.) Merr. | T | | | | | 1 | 1 | |
| Papilionaceae | <i>Tephrosia</i> sp. | H | | | | | 1 | | |
| Passifloraceae | <i>Passiflora edulis</i> Sims | C | 1 | 1 | 1 | 1 | | | Id |
| Phytolaccaceae | <i>Phytolacca dodecandra</i> L'H. r. | S | 1 | | | 1 | | | |
| Piperaceae | <i>Peperomia tetraphylla</i> (G. Forst.) Hook. & Arn. | H | 1 | | | 1 | | | HW |
| Piperaceae | <i>Piper capense</i> L. f. | H | 1 | 1 | | 1 | | | HW |
| Pittosporaceae | <i>Pittosporum viridiflorum</i> Sims | T | | | | | | 1 | |
| Plantaginaceae | <i>Plantago palmata</i> Hook. f. | H | | | | 1 | | | Hy |
| Podocarpaceae | <i>Podocarpus latifolius</i> (Thunb.) Mirb. | T | | | | 1 | | | |
| Polygonaceae | <i>Oxygonum sinuatum</i> (Meisn.) Dammer | H | 1 | | 1 | 1 | 1 | 1 | We. Id |
| Polygonaceae | <i>Polygonum setosulum</i> A. Rich | H | 1 | 1 | 1 | 1 | 1 | 1 | Hy |
| Polygonaceae | <i>Rumex usambarensis</i> (Dammer) Dammer | S | | 1 | 1 | 1 | 1 | 1 | HW |
| Polyodiaceae | <i>Lepisorus excavatus</i> (Bory ex Wild.) | H | | | 1 | 1 | | | |

| Family | Species | LF | R. Gikigie | R. Githaga | R. Irati | R. Maragua | Confluence | Lower Maragua | Description |
|------------------|---|----|------------|------------|----------|------------|------------|---------------|-------------|
| | Moore | | | | | | | | |
| Polyodiaceae | <i>Loxogramme abyssinica</i> (Baker) M.G. Price | H | | | | 1 | | | |
| Proteaceae | <i>Grevillea robusta</i> R.Br. | T | | 1 | 1 | 1 | | | Ex. |
| Pteridaceae | <i>Pteris caeloptera</i> Kunze | H | | | | 1 | | | |
| Ranunculaceae | <i>Ranunculus multifidus</i> Forssk. | H | | | 1 | | | | |
| Ranunculaceae | <i>Thalictrum rhynochocarpum</i> Dillon & A. Rich. | H | 1 | | | 1 | | | HW |
| Rhamnaceae | <i>Gouania longispicata</i> Engl. | C | | | | 1 | | | |
| Rosaceae | <i>Alchemilla kivuensis</i> Engl. | H | 1 | 1 | 1 | 1 | | | HW |
| Rosaceae | <i>Prunus africana</i> (Hook. f.) Kalliman | T | | | 1 | | | | |
| Rosaceae | <i>Rubus apetalus</i> Poir. | S | 1 | 1 | 1 | 1 | | | |
| Rosaceae | <i>Rubus keniensis</i> Standl. | S | | | | 1 | | | |
| Rosaceae | <i>Rubus pinnatus</i> Willd. | S | | | 1 | | | | |
| Rosaceae | <i>Rubus steudneri</i> Schweinf. | S | 1 | 1 | 1 | 1 | | | |
| Rubiaceae | <i>Breonsdia microcephala</i> (Vahl) Hepper & J.R.I. Wood. | T | | | | | | 1 | Hy/HW |
| Rubiaceae | <i>Galliera saxifraga</i> (Hochst.) Bridson | T | 1 | | | 1 | | | |
| Rubiaceae | <i>Keelia guinzui</i> (Sond.) Bridson | S | 1 | | | 1 | | | |
| Rubiaceae | <i>Meyna tetraphylla</i> (Hiern) Robyns | T | | | | 1 | | | |
| Rubiaceae | <i>Oldenlandia</i> sp. | H | | | 1 | | | | |
| Rubiaceae | <i>Pentas parvifolia</i> Hiern | H | | | | 1 | | | |
| Rubiaceae | <i>Psychohia</i> sp. | T | 1 | | | 1 | | | |
| Rubiaceae | <i>Ryngyria uhligii</i> (K. Schum. & K. Krause) Verdc. | T | | 1 | 1 | | | | |
| Rubiaceae | <i>Spermacoce princeae</i> (K. Schum.) Verdc. | H | 1 | 1 | 1 | 1 | | | HW |
| Rutaceae | <i>Clausena arisata</i> (Willd.) Benth. | T | | | 1 | | | | |
| Sapindaceae | <i>Allophylus abyssinicus</i> (Hochst.) Radlk. | T | | | | 1 | | | |
| Sapotaceae | <i>Synsepalum brevipes</i> (Baker) Engl. | T | | | | | | 1 | |
| Scrophulariaceae | <i>Veronica abyssinica</i> Fresen. | H | 1 | | 1 | 1 | | | |
| Selaginellaceae | <i>Selaginella kraussiana</i> (Kunze) A. Braun | H | 1 | | | | | | |
| Smilacaceae | <i>Smilax anceps</i> Willd. | C | | | 1 | | | | |
| Solanaceae | <i>Brugmansia suaveolens</i> (Humb. & Bonpl. ex Willd.) Benth. & J. Presl | S | | 1 | | 1 | | | |
| Solanaceae | <i>Calotropis procera</i> (Aiton) W.T. Aiton | S | | | | | 1 | | Id |
| Solanaceae | <i>Physalis peruviana</i> L. | H | | | | | 1 | | Id |
| Solanaceae | <i>Solanum campylacantha</i> L. | S | | | | | 1 | | Id |
| Solanaceae | <i>Solanum mauritanium</i> Scop. | S | | | | | 1 | | Id |
| Solanaceae | <i>Solanum nigrum</i> L. | H | | | | | 1 | | We. Id |
| Solanaceae | <i>Solanum terminale</i> Forssk. | C | | 1 | | 1 | | | |

| Family | Species | LF | R. Gikigle | R.Githaga | R. Irati | R. Maragua | Confluence | Lower Maragua | Description |
|------------------|--|----|------------|-----------|----------|------------|------------|---------------|-------------|
| Sterculiaceae | <i>Dombeya torrida</i> (J.F. Gmel.) Bamps | T | 1 | | | 1 | | | |
| Sterculiaceae | <i>Hermannia exappendiculata</i> (Mast.) K. Schum. | H | | | | | 1 | | |
| Sterculiaceae | <i>Waltheria indica</i> L. | H | | | | | 1 | | Id |
| Thelypteridaceae | <i>Christella dentata</i> (Forsk.) Brownsey & Jermy | H | 1 | 1 | 1 | 1 | | | |
| Tiliaceae | <i>Triumfetta brachyceras</i> K. Schum. | S | 1 | 1 | 1 | 1 | 1 | 1 | HW |
| Tiliaceae | <i>Triumfetta rhomboides</i> Jacq. | S | | 1 | 1 | 1 | 1 | 1 | |
| Tiliaceae | <i>Triumfetta tomentosa</i> Bojer | S | 1 | 1 | 1 | 1 | 1 | 1 | |
| Umbelliferae | <i>Agrocharis incognita</i> (Norman) Heywood & Jury | H | 1 | | 1 | 1 | | 1 | |
| Umbelliferae | <i>Anthriscus sylvestris</i> (L.) Hoffm. | H | | 1 | | | | | |
| Umbelliferae | <i>Centella asiatica</i> (L.) Urb. | H | 1 | 1 | 1 | 1 | 1 | 1 | HW |
| Umbelliferae | <i>Hydrocotyle sibthorpioides</i> Lam. | H | 1 | | 1 | 1 | 1 | 1 | HW |
| Umbelliferae | <i>Pimpinella</i> sp. | H | | | 1 | | | | HW |
| Umbelliferae | <i>Sanicula elata</i> D. Don | H | | 1 | | 1 | | | |
| Urticaceae | <i>Droguetia iners</i> (Forsk.) Schweinf. | H | | | | 1 | | | |
| Urticaceae | <i>Laportea alata</i> Hook. f. | H | | | | 1 | | | |
| Urticaceae | <i>Urera hypselodendron</i> (A. Rich.) Wedd. | C | | | | 1 | | | |
| Urticaceae | <i>Urtica massala</i> Muellb. | H | | | | 1 | | | |
| Verbenaceae | <i>Clerodendrum johnstonii</i> Oliv. | S | 1 | 1 | 1 | 1 | | | |
| Verbenaceae | <i>Lantana camara</i> L. | S | | | | | 1 | 1 | Id, in |
| Verbenaceae | <i>Rotheca myrtoides</i> (Hochst.) Vahlke | S | | | | | | 1 | Id |
| Verbenaceae | <i>Verbena bonariensis</i> L. | H | | | | | 1 | 1 | |
| Vitaceae | <i>Ampelocissus africana</i> (Lour.) Merr. | C | | | | 1 | | | |
| Vitaceae | <i>Cyphostemma kilimandscharicum</i> (Gilg) Wild & R.B. Drumm. | C | | 1 | | 1 | | | |
| Zingiberaceae | <i>Aframomum boccosus</i> | H | 1 | 1 | 1 | 1 | | 1 | ex |

Appendix IV: Algae species recorded in NCT1 Rivers

ALGAE SPECIES CHECKLIST OF NCT1 RIVERS

| | Phylum | Species | R.Githika | R. Irati | R. Gikigie | R. Maragua | Lower R. Maragua | Confluence of Maragua and Sagana |
|----|-----------------------------|----------------------|-----------|----------|------------|------------|------------------|----------------------------------|
| 1 | Chlorophyta (Green algae) | <i>Ankistrodemus</i> | 1 | | | 1 | | |
| 2 | Cynophyta/blue green algae) | <i>Aphanizomenon</i> | | | 1 | | | |
| 3 | Chlorophyta | <i>Characiopsis</i> | | | 1 | | | |
| 4 | Chlorophyta | <i>Characium</i> | | | 1 | 1 | | |
| 5 | Chlorophyta | <i>Chlorella</i> | 1 | 1 | 1 | 1 | 1 | |
| 6 | Chlorophyta | <i>Cladophora</i> | | | 1 | 1 | 1 | |
| 7 | Chlorophyta | <i>Closterium</i> | 1 | | 1 | | | |
| 8 | Chlorophyta | <i>Cosmarium</i> | 1 | | 1 | | | |
| 9 | Baccillariophyta (Diatoms) | <i>Cymbella</i> | 1 | 1 | | | | 1 |
| 10 | Baccillariophyta | <i>Fragularia</i> | | | | | 1 | |
| 11 | Baccillariophyta | <i>Gomphonema</i> | 1 | | | 1 | 1 | 1 |
| 12 | Chlorophyta | <i>Microspora</i> | | 1 | | | | |
| 13 | Baccillariophyta | <i>Navicula</i> | 1 | | | | | 1 |
| 14 | Chlorophyta | <i>Ophocytium</i> | | 1 | | | | |
| 15 | Cynophyta | <i>Oscillatoria</i> | | 1 | 1 | 1 | | |
| 16 | Baccillariophyta | <i>Pleurococcus</i> | 1 | | | | | |
| 17 | Baccillariophyta | <i>Surirella</i> | 1 | | | | | |
| 18 | Baccillariophyta | <i>Synedra</i> | | 1 | | | | |
| 19 | Chlorophyta | <i>Ulothrix</i> | 1 | | 1 | 1 | | |

Appendix V: Construction Plant and estimated Semi/skilled labour

ESTIMATED LABOUR

| Item No. | Class of Labor | Unit | Nominal Quantity |
|----------|---|------|------------------|
| 1 | Labor - unskilled | hr. | 200 |
| 2 | Labor - semi-skilled | hr. | 200 |
| 3 | Drillers - jackhammers | hr. | 200 |
| 4 | Drillers – air tracks | hr. | 200 |
| 5 | Drillers - rotary crawler over 150 mm | hr. | 200 |
| 6 | Powder-men | hr. | 200 |
| 7 | Carpenters | hr. | 200 |
| 8 | Reinforcing steel fixers | hr. | 200 |
| 9 | Concrete workers | hr. | 200 |
| 10 | Masons, concreters, bricklayers | hr. | 200 |
| 11 | Plasterers | hr. | 100 |
| 12 | Painters | hr. | 100 |
| 13 | Plumbers | hr. | 100 |
| 14 | Electricians | hr. | 100 |
| 15 | Welders | hr. | 100 |
| 16 | Fitters | hr. | 100 |
| 17 | Riggers | hr. | 100 |
| 18 | Truck drivers - 3 t to 6 t | hr. | 100 |
| 19 | Truck drivers - 15 t | hr. | 100 |
| 20 | Truck drivers - 50 t | hr. | 100 |
| 21 | Tractors operators - heavy (above 200 kw) | hr. | 100 |
| 22 | Tractors operators - light (under 200 kw) | hr. | 100 |
| 23 | Front-end loader operators - 2 m ³ to 3 m ³ | hr. | 100 |
| 24 | Front-end loader operators - 5 m ³ to 10m ³ | hr. | 100 |
| 25 | Shovel operator - 2 m ³ | hr. | 100 |
| 26 | Shovel operator - 5 m ³ | hr. | 100 |
| 27 | Roller drivers | hr. | 100 |
| 28 | Mobile crane operators | hr. | 100 |
| 29 | Compressor & pump attendants | hr. | 100 |
| 30 | Crusher / screening plant operator | hr. | 100 |
| 31 | Batch mixer | hr. | 100 |
| 32 | Plant operator | hr. | 100 |
| 33 | Oiler, greasers | hr. | 100 |
| 34 | Mechanics - up to 10 years experience | hr. | 100 |
| 35 | Mechanics - over 10 years experience | hr. | 100 |
| 36 | Foreman and gangers working with gang | hr. | 200 |
| | | | 4100 |

MATERIALS

| Item No. | Material | Unit | Nominal Quantity |
|----------|--|----------------|------------------|
| 1 | Ordinary Portland cement - bagged | t | 20 |
| 2 | Ordinary Portland cement - bulk | t | 20 |
| 3 | Fine aggregate | m ³ | 15 |
| 4 | Coarse aggregate | m ³ | 20 |
| 5 | Concrete mix at central batch plant characteristic strength 20 MPa, slump 80mm and maximum aggregate size 20mm | m ³ | 50 |
| 6 | Reinforcing steel | t | 5 |
| 7 | Reinforcing fabric | t | 2 |
| 8 | Structural steel | t | 2 |
| 9 | Explosive - gelatine | t | 1.5 |
| 10 | Explosive - ammonium nitrate | t | 1 |

PLANT AND EQUIPMENT

| Item No. | Class of Plant | Unit | Nominal Quantity |
|----------|---------------------------------------|------|------------------|
| 1 | Bulldozer 70kw | Hour | 40 |
| 2 | Bulldozer 150kw | Hour | 40 |
| 3 | Bulldozer 250kw | Hour | 40 |
| 4 | Hydraulic excavator 10-14t | Hour | 40 |
| 5 | Hydraulic excavator 15-24t | Hour | 40 |
| 6 | Hydraulic excavator 25-35t | Hour | 40 |
| 7 | Mobile crane 30t max | Hour | 40 |
| 8 | Mobile crane 50 t max | Hour | 40 |
| 9 | Track type loader 80kw | Hour | 40 |
| 10 | Concrete plant 60t/hr | Hour | 40 |
| 11 | Air compressors 5m ³ /min | Hour | 40 |
| 12 | Generator 15kw | Hour | 40 |
| 13 | Generator 150kw | Hour | 40 |
| 14 | Generator 365kw | Hour | 40 |
| 15 | Tipper truck 0-11t | Hour | 40 |
| 16 | Tipper truck 11-17t | Hour | 40 |
| 17 | Tipper truck 18-25t | Hour | 40 |
| 18 | Vibrating roller 8 t | Hour | 40 |
| 19 | Vibrating roller 12 t | Hour | 40 |
| 20 | Three wheel steel roller 10-15t | Hour | 40 |
| 21 | Tandem steel roller 12t | Hour | 40 |
| 22 | Vibrating Plate Compactor 0.4t | Hour | 40 |
| 23 | Jack hammer 25kg | Hour | 40 |
| 24 | Pick -up truck 1.7t | Hour | 40 |
| 25 | Crushing plant 150t/hr | Hour | 40 |
| 26 | Concrete mixer 15hp0.5m ³ | Hour | 40 |
| 27 | Concrete vibrator 35 mm diameter | Hour | 40 |
| 28 | Concrete vibrator 63 mm diameter | Hour | 40 |
| 29 | Self propelled water tanker 6,000l | Hour | 40 |
| 30 | Self propelled fuel tanker 6,000l | Hour | 40 |
| 31 | Water pump centrifugal 50 mm diameter | Hour | 40 |

Source: Modified from AWSB NCT1 bidding documents

Appendix VI: Public Consultation Records

APPENDIX VI: PUBLIC CONSULTATIONS

APPENDIX VI: PUBLIC CONSULTATIONS

VI-I: PUBLIC MEETINGS

**VI-II: STAKEHOLDER CONSULTATION FORMS AND
NOTES TO MEETINGS**

**VI-III: FOCUS GROUP DISCUSSIONS NOTES TO
MEETINGS**

VI-IV: PUBLIC DISCLOSURE WORKSHOP

APPENDIX VI-I: PUBLIC MEETINGS

1. PUBLIC MEETING AT ICHICHII LOCATION ON 11-08-2014
2. PUBLIC MEETING AT KIRURI LOCATION ON 12-08-2014
3. PUBLIC MEETING AT MAKOMBOKI LOCATION ON 13-08-2014
4. PUBLIC MEETING AT MAIRI- KANGARI LOCATION ON 13-08-2014
5. PUBLIC MEETING AT KINYONA LOCATION ON 14-08-2014
6. PUBLIC MEETING AT GACHARAGE LOCATION ON 14-08-2014

PUBLIC MEETING AT ICHICHII LOCATION ON 11-08-2014

**MINUTES OF THE PUBLIC MEETING FOR ESIA AND RAP FOR NORTHERN COLLECTOR TUNNEL
PHASE 1 HELD AT ICHICHI CHIEF'S CAMP AT 2.00 PM ON 11/08/2014**

Attendance, as attached.

MIN 1.2014. INTRODUCTION

The assistant chief of the area introduced his colleagues from other sub locations in Ichichi and the chief of the location who opened the floor for the GIBB AFRICA team's introduction.

MICHAEL KABARI WAWERU

Introduced himself as an environmentalist from GIBB AFRICA LTD. Which is an international company for consultation, design and management. He explained the role of the company as a field of experts for consultation on different areas including environmental, engineering, water and many others of the kind.

JACOB OMONDI

Introduced himself as a sociologist from GIBB Africa Ltd whose work is to study the socio-economic aspect that arise as a result of any project carried out.

Stated that Gibb Africa had been consulted by Athi Water Services Board(a government parastatal) to carry out a study on the Environmental and social effects of a project they proposed on the area. The study will help find out who will be affected by the project(construction of a tunnel from Maragua river to Ndakaini dam).

FLORENCE SIALO

An environmental science student currently on internship at GIBB Africa, to assist and get skills on the project and the ESIA and RAP study

MIN.2.2014 ... the project

The government of Kenya has received funds from the World Bank for the Water and sanitation Improvement project(WaSSIP) and Agence Francaise De Development (AFD).An Environmental and Social Impact Assessment(ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi city-Northern collector tunnel, a Raw Water Pipeline, Raw Water treatment Works situated at Kigoro downstream of Thika dam and Treated Water pipeline to Kabete reservoir. AWSB which is to implement the project on behalf of Gok has contracted GIBB Africa to develop a RAP to mitigate on impact on property.

The project involves Construction of a tunnel from maragua river in Ichichi to Ndakaini(Thika dam). The tunnel will collect water from three rivers within Muranga county namely;Maragua river, Gikigie river and Irati river in proportions of the ratio 3:1:2 respectively according to the size of the respective rivers. The water collected will outpour at Githika river which is an inlet to Thika dam. The water flows to Kogoro treatment plant where it will be treated and flows to Ngethu river which supplies water to Nairobi and its neighbouring towns like Kiambu, Kajiado etc. A map was used to illustrate the description.The project the inlets of the rivers to the tunnel, there will be wiers constructed to prevent back flow of water at the inlets, the sizes of the wiers also vary depending on the size of the river: At Maragua river a wier will be 20m by 5m,at Gikigie river the wier will be 14m by 3.3m and at Irati river it will be 20m by 4.4m. Here some water will overflow to people's lands. Inaddition to this, there will be adit portals which will be used to access the main tunnel.

MIN 3.2014 PROCEDURE FOR THE STUDY

The meeting was briefed on the expected effects from the project ; positive impacts- improvement of infrastructure, employment opportunities, expansion of businesses in the area during and after the project etc. Negative effects- Immorality, Safety and security of the community. The project is expected to affect the environment as well as the people's livelihoods where it will affect land, structures and such like property.

The study will start with public consultation of which this was the first one, followed by surveying which will peg out the exact affected property followed by a census on the specific identified pieces of land. The census is conducted to get the details of the project affected persons(PAPS) and this will help in compensation and resettlement of the PAPS, the requirements for the census were stated including; A copy of ID, A copy of the title deed and other supporting documents for the same. The dates of the census were specified to be 18th Aug to 4th Sep after which no census will be conducted 4th Sep is the cut-off date.

Meetings will also be held with focus groups including men, women and children to find out their specific issues at the various levels. The community was requested to name any features of cultural heritage within the area so as not to be tampered with during construction. The chief gave a rough estimate of the names of the people likely to be affected by the project. Any restrictions on land use will be given by AWSB.

MIN 4.2014.ISSUES

1. The water is being tapped and it is what the community is utilizing for domestic uses and irrigation.

RESPONSE

- There are several water users of the river who might be impacted. Therefore, to mitigate this there is a hydrological study currently being undertaken to determine water usage, demand vis-a vis what is to be abstracted. This has at the initial stage determined that there is possibility of abstraction with minimal impact but the current ESIA study will also check on the viability of abstraction
 - The community was also urged to tell the study what they are using water for and how they will be impacted.
 - The community was also taken through the water projects that Athi Water Services Board has proposed for the project.
2. Hassan Gikonyo noted that during previous studies the contractors who were undertaking these constructions did a lot of social evils , how will this project then ensure this will not happen again.
 - An Environmental and Social Management Plan will be developed to act as a check for the required best practice and this will propose for a monitoring plan.
 3. Will persons surveyed for social economic studies be compensated?
 - A committee will not be formed at this stage but after the study will have been done, a committee for grievance solutions and implementation will be formed in close consultation with the local administration and Project Affected Persons (PAPs).
 - The baseline survey will be done to show how the community is living in the project area and the Focused Group Discussions with the Elders and the youths will be done also to get in depth knowledge of the impacts and suggestions.
 4. The compensation that might be paid, will it be a full payment as it will restrict on the usage of the area to the future generations?

- The easement will lead to a co-ownership of the area. But it is proposed that the area is acquired for a controlled development ,as in some activities will not be allowed.
5. Where will cut-to spoil be dumped?
 - It was communicated to the community that there are areas of cut-to- spoil that have been identified, but in case the waste is usable for example on road development, they will be used.
 6. How will the roads be taken care of during construction?
 - The contractor will ensure the roads are maintained in proper condition.
 7. Mr. Maina asked whether there will be impacts such as creation of a fault line after earthquakes(in case it happens)
 - It was noted that there are geological studies being undertaken and it will have proposals on how such occurrences will be dealt with.
 8. The community initially knew that a dam will be constructed. Therefore, will the dam be constructed along with the tunnel?
 - No, the tunnel has taken place of the dam due to greater impacts that would have rose due to construction of the dam, it was also so costly to construct the dam.
 9. The construction might interrupt schooling in the area. How will the project facilitate development in this area?
 - It was noted that consultations have been conducted with Education Stakeholders and they also noted that the schools could be impacted by the construction so the camp site will be located far from residential areas.

NOTE: The PAPs will be given a survey ID after the survey.

10. Will there be restriction on activities to be carried out of the 3m way leave?
 - No restriction out of the 3m.
11. In case in future or during the construction period other resources are found in the area such as oil, will the community be paid additional compensation?
 - The people who will be responsible for extraction of such resources will communicate with the community of the developments.
12. A member of the community suggested there be expansion of a water project- Gathaini water project & Karura water project in Ichichi location.
13. How will the contractor be protected from accidents and may be death?
 - Records of people working will be taken and PPE's must be provided.
 - Insurance will be provided as in the law.
14. How will the project ensure that all those affected are compensated?
 - It was communicated that compensation will be paid to everyone after a decision has been taken by AWSB.
15. Will persons who have subdivided land be assessed as individuals or individuals and beneficiaries?
 - After consultations with the community noted that all individuals be compensated as individuals despite sharing a title deed.

MIN 5.2014 CLOSING The chief thanked the members of his community for their commitment and response to the call despite a short notice time and also for their participation throughout the meeting. He also thanked the consulting team for the information provided. He requested for the roads to be constructed before commencement of the project. Also requested for compensation before construction begins. The meeting ended at 16.32 pm with a prayer from a member of the community.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION ~~KICHICH~~
KICHICH

DATE 11/03/2014

DISTRICT K. P. O. S. M. A.









| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|----------------------|-----------|--------------------|--------------|----------------|
| RUTH WAMBUI CHEGE | | ICHICH | 0723476312 | R. Wambui |
| BUSAN GITISO | | ICHICH | 07214389268 | She: |
| TITUS Ngabe Mwangi | | ICHICH | 0714389268 | Titus |
| Amal wanyceke mwangi | | KARURA KICHICH | 0712290237 | |
| SPONSOR KIMEMA | 785 2681 | ICHICH | 6716 50 9981 | Sponsor Mwangi |
| BENSON KABUNGA Kim | 134 59925 | ICHICH | | |
| SEMER MUKA | 27979585 | GIOTOKE | 072512960 | |
| Francis K. Wihanga | 1001465 | ICHICH | 0717481091 | Francis |
| JAVIA MUGO CHEGE | 3686222 | KARURUMO | 0751881023 | Javia |
| JARIA WACHUKI | 12836945 | KARURUMO | | Jaria |
| SAMUEL K. KABORO | 13652798 | NDUNI | 0728473572 | Samuel |
| SAMUEL-K. MACHUKU | 7570852 | KARURA | 0711866793 | Samuel |
| Omondil Jacob | 24978206 | GIBB AFRICA Ltd | 0721371816 | Omondil |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION Uthmaniyah.....

DATE 01/07/2014.....

DISTRICT Uthmaniyah.....

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|---------------------|-----------|---------|------------|---|
| JULIUS M. MORDAN | 87078638 | KORORA | 0713755054 |  |
| EMINI HANERU | 0734458 | MAHICHI | 0727737762 |  |
| SESTON KOPPERI | 0921483 | MAHICHI | 0783344290 |  |
| EMES MORDAN | ✓ | MORINI | ✓ | ✓ |
| SAMUEL K. CHAGAT | 3601739 | MORINI | 0702086537 |  |
| MYRIE CAPTIRU | 5439471 | MORINI | 0717882987 | |
| JULIUS MORDAN | ✓ | MORINI | ✓ | |
| SESTON KOPPERI | | MORINI | ✓ | |
| ZACHARY KIMONI | 8486300 | MOROR | 0724569987 | |
| Shunip Mawia | 3670387 | MAHICHI | 0728242820 |  |
| WANGELI CUTOLO BHAY | 4052079 | MAHICHI | 073328354 |  |
| Paul Kube Munga | 1332792 | | 0727625689 |  |
| SAMUEL RAMZAN | 3670341 | MORINI | 0712275268 |  |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION *MW. CHA*.....

DATE *11/08/2014*.....

DISTRICT *Karurua*.....

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|------------------------------|-----------------|-----------------|-------------------|--------------------|
| <i>PASSAN GILGOMHO KUBIA</i> | <i>11002000</i> | <i>NDUINI</i> | <i>0713425909</i> | <i>[Signature]</i> |
| <i>Josiah Kimetho Kamugi</i> | <i>16099297</i> | <i>KABARA</i> | <i>0710216875</i> | <i>[Signature]</i> |
| <i>Jesse Kangi Gichina</i> | <i>3670100</i> | <i>Nduini</i> | <i>0714325889</i> | <i>[Signature]</i> |
| <i>Kabuagi Njoro</i> | <i>3670644</i> | <i>Nduini</i> | <i>-</i> | <i>[Signature]</i> |
| <i>Daniel Njome Ndome</i> | <i>3732555</i> | <i>Ichichia</i> | <i>0729223229</i> | <i>[Signature]</i> |
| <i>S. Njitha waigwale</i> | <i>6240293</i> | <i>Ichichia</i> | <i>-</i> | <i>[Signature]</i> |
| <i>Mwakai MW. GILGOMHO</i> | <i>1733078</i> | <i>MURANI</i> | <i>-</i> | <i>[Signature]</i> |
| <i>STANLEY KAMU</i> | <i>3670251</i> | <i>MURANI</i> | <i>-</i> | <i>[Signature]</i> |
| <i>KILIGOMHO JOSEPH K</i> | <i>7606123</i> | <i>MURANI</i> | <i>-</i> | <i>[Signature]</i> |
| <i>AMOS K. MURANI</i> | <i>2114419</i> | <i>KARURA</i> | <i>0708289156</i> | <i>[Signature]</i> |
| <i>KAMUKI MURANI</i> | <i>2044327</i> | <i>MURANI</i> | <i>-</i> | <i>[Signature]</i> |
| <i>SWI KOLUWA</i> | <i>3270679</i> | <i>KARURA</i> | <i>-</i> | <i>[Signature]</i> |
| <i>Stephan M. Gilgoma</i> | <i>2961030</i> | <i>-</i> | <i>-</i> | <i>[Signature]</i> |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION J. Chichichi

DATE 11/02/2014

DISTRICT Kapchorwa

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|------------------------|-----------------------|----------|------------|-----------------|
| Jane wanjiru | 7911247 0710203345 | KARURA | 0710203345 | |
| GRACE MUTHONI | 23957446 | KARURA | 0718793143 | |
| TRISTHA NYAMBURA K | | KARURA | | |
| MARITHA WAHJIRU | | ICHICHI | | |
| LUCY NYAMBURA K. | 2231403 | KARURA | 0727085208 | |
| REGINDIA WARUINU N. | 200927768 36702 | KARURA | | |
| David mwingi macharia | 1217297 | ICHICHI | 07134131 | <i>David</i> |
| Deniel washuma karanta | 3670384 | KARURA | 0716609725 | <i>Deniel</i> |
| NANCY WANJIRU NJUBUNT | 9506978 | KARURA | 0718578340 | NANCY |
| ELISHIFA MUTHONI | | ICHICHI | 0705581186 | <i>Elishifa</i> |
| Esther MUTHONI | 30114400 | KARURUNO | 0718042090 | GA |
| Monica WAMBUI | 7911927 | ICHICHI | 0731218530 | MICHA |
| JANE GITHIGA | | ICHICHI | | <i>Jane</i> |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION (ICHICHI)

DATE 11-08-2014

DISTRICT KANGENDA

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|--|-----------|---------|------------|-----------|
| ALEX MAINA KHARANT CHEGE | 3064263 | ICHICHI | 0731189414 | Alex M. |
| PETER NJOROGE | 113712402 | NDUINI | 0724397629 | Peter |
| JAMES MWANGI | 11373387 | ICHICHI | 0789147250 | James |
| JOHN MWANIKI | 70609771 | NDUINI | 072400353 | John |
| JOHN CHEGE | 20753656 | NDUINI | 072998206 | John |
| ALICE WANJIRU | 2147331 | ICHICHI | 0721701397 | — |
| JAMES GITHU | 24228089 | ICHICHI | 0724544594 | IG |
| HELLEN GIACAMBI | 13509983 | ICHICHI | 0729985927 | HGM |
| ROSEMARY Wanjiru NJIRI | 23620526 | ICHICHI | 0713591887 | Rosemary |
| JANIEL KAMAN GIACHUTHI | 8840107 | NDUINI | 0711344063 | Januel |
| Maryanne muthoni | 26966335 | Karura | 0714170688 | Maryanne |
| Maryanne nyambura Kanyini | 5917022 | Karura | 0714036892 | Maryanne |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION ICHICHI

DATE 11-08-2014

DISTRICT KANGEMA
MURANGA

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|---------------------|-----------|-----------|------------|--------------------|
| DOUGLAS KANTANJA | 0787526 | NDUJI-INI | 0713600151 | <i>[Signature]</i> |
| BETH NDOKI | 26240987 | NDUJI-INI | 0787504939 | <i>[Signature]</i> |
| BENSON MACHARIA | 23769482 | NDUJI-INI | 0711935745 | <i>[Signature]</i> |
| JANE WANJIRU K. | 3670314 | NDUJI-INI | 0722572437 | <i>[Signature]</i> |
| RUTH WAKIMU | 5607852 | ICHICHI | 0724140502 | <i>[Signature]</i> |
| GEORGEY KIHUNYU | 7083241 | ICHICHI | 0721542857 | <i>[Signature]</i> |
| GEORGE MAINA | - | ICHICHI | 0710452408 | <i>[Signature]</i> |
| GERUSHOM MAINA | 20552228 | KARURA | 0720820354 | <i>[Signature]</i> |
| PETER GACHAMU | 12642143 | KARURA | 0729881026 | <i>[Signature]</i> |
| ISAK KAMANJA | 13123164 | KARURA | 0710136574 | <i>[Signature]</i> |
| FAITH MUTOTONI | 44470896 | KARURA | 0706846860 | <i>[Signature]</i> |
| OPHANTIAS K. HANGA | 23074813 | ICHICHI | 072701647 | <i>[Signature]</i> |
| LOISE . N. GITHINJI | 14490868 | ICHICHI | 0720405837 | <i>[Signature]</i> |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION (ICHICHI)

DATE 11-08-2014

DISTRICT KANISAMA

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|-----------------------|-----------|---------|------------|----------------|
| BENSON NGOTHO K | 3670658 | KARURA | 0773485013 | <i>Benson</i> |
| JAMES MOINE PHARU | 3686740 | KARURA | 0788681893 | <i>Moine</i> |
| PAUL MWANTAN NDERU | 2027276 | Ichichi | 0722362614 | <i>Paul</i> |
| Samuel Moine Phangora | 2445124 | Ndini | 0710277228 | <i>Samuel</i> |
| JAMES MURITHI | 1867384 | ICHICHI | 0734055706 | <i>James</i> |
| HEZRON KIHANGA M. | 3670305 | ICHICHI | 0713566646 | <i>Hezron</i> |
| PETER NGARI | 3670332 | ICHICHI | 0713304364 | <i>Peter</i> |
| ALBERT K. MBATIA | 5916912 | ICHICHI | 0723649203 | <i>Albert</i> |
| MERCY WANGICHEI | 11667967 | ICHICHI | 074746453 | <i>Mercy</i> |
| SIMON NDUGIZE | 11373093 | KARURA | 0724876792 | <i>Simon</i> |
| ANTHONY NDERU | 23920050 | NDUTINI | 0716729298 | <i>Anthony</i> |
| IBHN NDUNGU | 22538943 | KARURA | 070679715 | <i>Ibhn</i> |
| JOSEPH KIHUNGU | 26102960 | ICHICHI | 0703496054 | <i>Joseph</i> |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION KALICHALI...SHEKETS...AMV

DATE 11/02/2011

DISTRICT ...

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|------------|-----------|-----------|------------|-------------|
| BABCO ... | | KALICHALI | / | |
| REKAR ... | 207 | / | / | |
| EREP ... | | / | | |
| HANNA ... | | KALICHALI | | |
| HEVEN ... | | | | |
| PANU ... | 0651141 | KALICHALI | 0710846633 | [Signature] |
| JOHN ... | 3132137 | KALICHALI | 0733238524 | [Signature] |
| JOHN ... | | KALICHALI | / | |
| MULTA ... | 5234372 | KALICHALI | / | |
| PETEN ... | | KALICHALI | / | |
| SPRINK ... | | KALICHALI | / | |
| HELE ... | | KALICHALI | / | |
| GOPI ... | | KALICHALI | / | |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE I

LOCATION KICHICHU C.H.I.E.F.A. ...
CAMP.

DATE 11.05.2014

DISTRICT KANGEMA

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|----------------------|-----------|---------|--------------------------|-----------|
| JAMES MUYENYI | 26646434 | GARET | 0712720123 0732813320 | |
| JAMES KAMU | 1167258 | NDUMI | 0776243766 | |
| JAMES G. M. | 12336049 | KARORA | 0701134463 | CKA |
| ZACHARY CHOPU | 22253705 | KARORA | 07139137904 | |
| HIRAM G. KIRAI | 9947385 | Ndumi | 0716707618 | Hiram |
| LABAN K. KIRAI | 26714236 | Ndumi | 0718316187 | LAB |
| STEPHEN NJORGE | 10949239 | ICHICHI | 0725704214 | SD |
| Peter N. KIRAI | 3670284 | Ichichi | 078852585 | Peter |
| PETER K KAMUKA | 1936590 | Ichichi | 074897205 | PK |
| James Kwaingu Gutesu | 1332825 | Ichichi | 071704485 | James |
| Peter Njoroge | 5916417 | Ndumi | 0711572793 | Peter |
| JOHN KIRETHI MUKHA | 2181783 | ICHICHI | 0794398758 | John |
| ALEX KAMUKIYE | 1902328 | KARUMO | 0731646001 | Alex |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION ICHICHU CHIEF.....

DATE 11/8/2014

DISTRICT KANGEMA

CAMP














| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|------------------------|-----------|-----------|------------|-------------|
| David Njuguna Thuo | 1387676 | ICHICHU 1 | 0711713903 | [Signature] |
| Namashoo Kibung' Ndome | 7199740 | Nduni | 0723099766 | [Signature] |
| David KAMAU | 10343214 | ICHICHU 1 | 0770330780 | [Signature] |
| JOHN KAMAU | 11749379 | ICHICHU 1 | 0725940350 | |
| PETER KAMAU | 10922467 | ICHICHU 1 | 0716341134 | |
| JOHN MURIKI | | ICHICHU 1 | | |
| TRAVIS MBERO | 12941344 | KARORA | 072791271 | |
| STEFAN NYOROG | 26241928 | KARORA | 0720915116 | |
| DAVID K. MAINA | 5919080 | ICHICHU | 0710246720 | [Signature] |
| WILLSON MATHU GITHIKA | | ICHICHU | | [Signature] |
| SPENCE MURUGA | 13743156 | GATEPA | 071170076 | |
| SHARON GITHU GITHIRO | 2472261 | ICHICHU | 0721602440 | |
| MICHAEL NYOROG | 7174405 | NDANI | 0723170227 | [Signature] |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION ... ICHICHI ... CHIEF ...

DATE 11.06.19
CAMP

DISTRICT KANGEMA

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|-------------------------|-----------|---------|-------------|---|
| CHARLES KAMUNJA KAMUNJA | 23559872 | NDU-INI | 0725-744278 |  |
| NJORGE MARYARA | | NDU-INI | 0 |  |
| DAVID MUTIGA | 3670439 | ICHICHI | 0700095952 |  |
| JOSEPH KAMAU C. | 360953 | NDU-INI | 0724132250 |  |
| NAHASHON K. THIONG'O | 6398872 | NDU-INI | 0703115131 |  |
| RAHAB WAIRIMA | 3703517 | KIARU | 0712934059 |  |
| STEPHEN MWANIKI | 13703945 | NDU-INI | 0732896104 |  |
| BICKSON MBOJIA M. | 0787617 | KARURUA | 0786080101 |  |
| JACKSON KAMUNJA | 9942252 | ICHICHI | 0726599700 |  |
| SAMUEL M. KURUGA | 0746154 | ICHICHI | 0724001973 |  |
| PAUL M. MACHARIA | 9827073 | GATARA | 0722473909 |  |
| CHARLES MURUGI WANGARI | 1355854 | ICHICHI | 0736529267 |  |
| MOSES MIBUTHIA | 28024450 | NDU-INI | 0726034481 |  |

Public Meeting Attendance

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION ICHICHI CHIEF'S
CAMP

DATE 11.08.2014

DISTRICT KANGEMA

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|-----------------------|-----------|----------|------------|---|
| PETER Mwangi | 10609281 | KITHOTIE | 0700509091 |  |
| PETER Mwangi | 20685757 | KAMUKA | 0727378709 |  |
| JACKSON METU | 11749396 | ICHICHI | 0715573577 | J |
| STEPHEN G. NBAHU | 3595477 | GATARIO | 0720242226 |  |
| JOHN K. ABERU | 7174207 | KAMUKA | 072363025 | John |
| HARUN K. KAMUNGO | 3703293 | KARURA | 070576634 | H |
| Fonsler opala | 2600557 | Kibaki | 0733411697 |  |
| FRANCIS GITHIGITH | 30064424 | ICHICHI | 0706308411 |  |
| PAUL K. MUMARI | 2269205 | Mwawaru | 0711280674 | Paul |
| Joshua Mwangi Mwangi | 3670400 | Ichicha | 0713680498 | Mwangi |
| Samuel Mungu Mwangi | 7174336 | Ichicha | 0734246308 |  |
| Samuel Machelwa Mungu | 084208 | Ichicha | 070252752 | Samuel |
| Joseph M. N. KAKUKU | 6484181 | ICHICHI | 0722647278 |  |

Public MEETING ATTENDANCE

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION UMAI CHIEFS CAMP

DATE 11/03/2014

DISTRICT Narayan











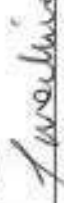


| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|------------------------|-----------|---------|--------------------------|-----------|
| Paul Melto | 7098589 | yilase | 071400700 | P. Melto |
| P. Abdul Kader Mohamed | 0345720 | Karime | 0714919586 | Pahad. |
| Paul Meece Gonyi | 3619076 | KAROR | 0715194330 0715147474 | |
| Paul MITHU G | 8372022 | KACHAI | 0736389427 | |
| James M. MYPAN | 3600137 | NDWANI | 0714722228 | |
| John K. WOROGE | 0445698 | NDWANI | 0724536870 | |
| James K. M. | 2242240 | KACHAI | 0727323296 | J.K.M. |
| PIKER CHITWANI | 13432683 | KACHAI | 0715194303 | PKR |
| Paul K. THORGO | 7670236 | NDWANI | 0729427423 | |
| DANSON K. K | 22439071 | KARORA | 0720710669 | Danson K. |
| Joseph K. N | 31730406 | KACHAI | 0701545043 | Joseph K. |
| | | | | |
| | | | | |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION ...S.H.I.S.H.I.I...C.H.I.G.F.S
CAMP

DATE ...11/08/14.....

DISTRICTKANGEMA.....

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|------------------------|-----------|----------|-------------|---|
| Henson GITHU MUAJI | 2777941 | ICHICHI | 0718489167 |  |
| SAMUEL CHEGWE BUNGU | 26601278 | KARURA | 0723070775 |  |
| Samuel Mugwero | 8633162 | ICHICHI | 0729775208 |  |
| JACKSON KIMANI | 10488093 | ICHICHI | 072252013 |  |
| KAGANU KAMATHI | 8483360 | ICHICHI | 0735196671 |  |
| JAMES M. KABIRO | 6883369 | ICHICHI | 0726975729 |  |
| JOSEPH M. MWANGI | 24170045 | ICHICHI | 0726909012 |  |
| STEPHEN MWAUURA | 73232041 | ICHICHI | 0720-256506 |  |
| JOITO GAKODIA | 13802255 | KARURA | 0713548441 |  |
| SAMUEL WAREHIBU KUMANI | 9019066 | KARURA | 0715035931 |  |
| FRANCIS K. KIKUMUYU | 4553843 | NAMI-IMI | 0727680060 |  |
| NEHEMIAH KIGORO | 367085 | ICHICHI | 072022950 |  |
| JOSEPH GICHOGU | 11334117 | KARURA | 0720892367 |  |

PUBLIC MEETING AT KIRURI LOCATION ON 12-08-2014

MINUTES OF THE PUBLIC MEETING FOR ESIA AND RAP FOR NORTHERN COLLECTOR TUNNEL
PHASE 1 HELD AT KIRURI AT 14:51 HRS ON 12/08/2014

Attendance, as attached.

MIN 1.2014. INTRODUCTION

The chief of the area introduced the consulting team to the members of the community opened the floor for the GIBB AFRICA & AWSB team's introduction.

MICHAEL KABARI WAWERU

Introduced himself as an environmentalist from GIBB AFRICA LTD. Which is an international company for consultation, design and management. He explained the role of the company as a field of experts for consultation on different areas including environmental, engineering, water and many others of the kind.

JACOB OMONDI

Introduced himself as a sociologist from GIBB Africa ltd whose work is to study the socio-economic aspect that arise as a result of any project carried out.

Stated that Gibb Africa had been consulted by Athi Water Services Board(a government parastatal) to carry out a study on the Environmental and social effects of a project they proposed or the area. The study will help find out who will be affected by the project(construction of a tunnel from Maragua river to Ndakaini dam).

FLORENCE SIALO

An environmental science student currently on internship at GIBB Africa, to assist and get skills on the project and the ESIA and RAP study

AWSB TEAM:

DANIEL MBUGUA

Introduced himself as a community development assistant in AWSB and his role is to find out the socio-economic effects of the proposed project to the community here in. AWSB has been tendered by the government to carry out the project and has thus contracted GIBB Africa for consultation on the same for ESIA and RAP study.

EUNICE CHERUTICH

She is an environmentalist in AWSB who's an expert in the field as well as for RAP and ESIA studies.

MIN.2.2014 ... the project

The government of Kenya has received funds from the World Bank for the Water and sanitation Improvement project(WaSSIP) and Agence Francaise De Development (AFD).An Environmental and Social Impact Assessment(ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi city-Northern collector tunnel, a Raw Water Pipeline, Raw Water treatment Works situated at Kigoro downstream of Thika dam and Treated Water pipeline to Kabete reservoir.

AWSB which is to implement the project on behalf of Gok has contracted GIBB Africa to develop a RAP to mitigate on impact on property.

The project involves Construction of a tunnel from maragua river in Ichichi to Ndakaini(Thika dam). The tunnel will collect water from three rivers within Muranga county namely;Maragua river, Gikigie river and Irati river in proportions of the ratio 3:1:2 respectively according to the size of the respective rivers. The water collected will outpour at Githika river which is an inlet to Thika dam. The water flows to Kogoro treatment plant where it will be treated and flows to Ngethu river which supplies water to Nairobi and its neighbouring towns like Kiambu, Kajiado etc. A map was used to illustrate the description.The project the inlets of the rivers to the tunnel, there will be wiers constructed to prevent back flow of water at the inlets, the sizes of the wiers also vary depending on the size of the river: At Maragua river a wier will be 20m by 5m,at Gikigie river the wier will be 14m by 3.3m and at Irati river it will be 20m by 4.4m. Here some water will overflow to people's lands. Inaddition to this, there will be adit portals which will be used to access the main tunnel.

MIN 3.2014 PROCEDURE FOR THE STUDY

The meeting was briefed on the expected effects from the project : positive impacts- improvement of infrastructure, employment opportunities, expansion of businesses in the area during and after the project etc. Negative effects- Immorality, Safety and security of the community. The project is expected to affect the environment as well as the people's livelihoods where it will affect land, structures and such like property.

The study will start with public consultation of which this was the first one, followed by surveying which will peg out the exact affected property followed by a census on the specific identified pieces of land. The census is conducted to get the details of the project affected persons(PAPS) and this will help in compensation and resettlement of the PAPS, the requirements for the census were stated including; A copy of ID, A copy of the title deed and other supporting documents for the same. The dates of the census were specified to be 18th Aug to 4th Sep after which no census will be conducted 4TH Sep is the cut-off date.

Meetings will also be held with focus groups including men, women and children to find out their specific issues at the various levels. The community was requested to name any features of cultural heritage within the area so as not to be tampered with during construction. The chief gave a rough estimate of the names of the people likely to be affected by the project. Any restrictions on land use will be given by AWSB.

MIN 4.2014.ISSUES

1. The water is being tapped and it is what the benefit of the community because they conserve the forest that the water is to be taken from- their consideration

RESPONSE

- The community was also urged to tell the study what they are using water for and how they will be impacted.
 - The community was also taken through the water projects that Athi Water Services Board has proposed for the project.
 - There was a suggestion for piped water to directly benefit the community members.
2. Reduction of water in the rivers will cause adverse effects on irrigation and economic activities like fishing

- No restriction on fishing or other economic activities.
3. The compensation that might be paid , will it be a full payment as it will restrict on the usage of the area to the future generations?
 - The easement will lead to a co-ownership of the area. But it is proposed that the area is acquired for a controlled development ,as in some activities will not be allowed.
 4. How will the roads be taken care of during construction?
 - The contractor will ensure the roads are maintained in proper condition.
 5. The community initially knew that a dam will be constructed. Therefore, will the dam be constructed along with the tunnel?
 - No, the tunnel has taken place of the dam due to greater impacts that would have rose due to construction of the dam, it was also so costly to construct the dam.

NOTE : The PAPs will be given a survey ID after the survey.

6. How will the contactor be protected from accidents and may be death?
 - Records of people working will be taken and PPE's must be provided.
 - Insurance will be provided as in the law.
7. Will there be a map showing the PAPs?
 - After the study, AWSB will be requested for the same.
8. How long is the project proposed to take before completion?
 - A period of 3yrs after licensing by NEMA.
9. How safe is the project with regards to landslides?
 - After the study, the risk will be learnt and there will be a briefing on the same.

MIN 5.2014 WATER PROJECTS IN THE AREA

- A. Gatagwago water project- proposed to serve Karurumo (Kiruri) location it is a communitywater project from Chianya river.
- B. Wangi tea buying centre an on- going water project, request to assist in completion of this project.
- C. Suggestion for upgrading of roads as well as provide safe water to residents of the area.

MIN 6.2014 CLOSING














The chief thanked the members of his community for their commitment and response to the call despite a short notice time and also for their participation throughout the meeting. He also thanked the consulting team for the information provided. He requested for the roads to be constructed before commencement of the project. The meeting ended at 16.30 pm with a prayer from a member of the community.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION K. RUEL - KARIKORO.....

DATE R.L.D.R.R.F.....

DISTRICT KANGEMA.....

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|-------------------------|-----------|---------|--------------------------|---|
| Thomas G. Macharia | 13101497 | Tuthu | 0700527076 |  |
| Henan W. Mutithi | A300792 | Karummo | 0735893121 0714529877 |  |
| John M. Muthoro | 3702401 | Kimiri | 0734704540 |  |
| Thomas M. Kirubi | 8632478 | Kimiri | 0713976754 |  |
| Peter Maana Kamathi | 6103707 | Karummo | 0734844822 |  |
| Peter Chuma Kirika | 3052649 | Karummo | 0714910954 |  |
| Anthony Mwangi Muenia | 7570524 | Karummo | 0725752713 |  |
| Premard Gatoto Mbatia | 3592258 | Karummo | 0717363193 |  |
| Consolata Wangari Wangi | 22167469 | Karummo | 0713939177 |  |
| Frica Wathira Macharia | 3686055 | Karummo | 0711263066 |  |
| Margaret Wangari Mitemu | 3052522 | Karummo | 0710650307 |  |
| Richard Gatoto Wangari | 14651609 | Ichicha | 0728073689 |  |
| Esther Nyiri Kauri | 13508364 | Kimiri | 0728552855 |  |

PUBLIC MEETING AT MAKOMBOKI LOCATION ON 13-08-2014

**MINUTES OF THE PUBLIC MEETING FOR ESIA AND RAP FOR NORTHERN COLLECTOR TUNNEL
PHASE 1 HELD AT MAKOMBOKI AT 10:30 AM ON 13/08/2014**

Attendance, as attached.

MIN 1.2014. INTRODUCTION

The chief of the area introduced the consulting team to the members of the community and opened the floor for the GIBB AFRICA & AWSB team's introduction.

MICHAEL KABARI WAWERU

Introduced himself as an environmentalist from GIBB AFRICA LTD. This is an international company for consultation, design and management. He explained the role of the company as a field of experts for consultation on different areas including environmental, engineering, water and many others of the kind. The consultation being undertaken is to aid in writing ESIA and RAP reports for the proposed project.

JACOB OMONDI

Introduced himself as a sociologist from GIBB Africa Ltd whose work is to study the socio-economic aspects that arise as a result of any project carried out.

Stated that Gibb Africa had been consulted by Athi Water Services Board (a government parastatal) to carry out a study on the Environmental and social effects of a project they proposed on the area. The study will help find out who will be affected by the project (construction of a tunnel from Maragua river to Ndakaini dam)

FLORENCE SIALO

An environmental science student currently on internship at GIBB Africa, to assist and get skills on the project and the ESIA and RAP study.

AWSB TEAM:

DANIEL MBUGUA

Introduced himself as a community development assistant in AWSB and his role is to find out the socio-economic effects of the proposed project to the community here in. AWSB has been tendered by the government to carry out the project and has thus contracted GIBB Africa for consultation on the same for ESIA and RAP study.

EUNICE CHERUTICH

She is an environmentalist in AWSB who's an expert in the field as well as for RAP and ESIA studies.

MIN.2.2014 ... the project

The government of Kenya has received funds from the World Bank for the Water and sanitation Improvement project (WaSSIP) and Agence Francaise De Development (AFD). An Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi city-Northern collector tunnel, a Raw Water Pipeline, Raw Water treatment Works situated at Kigoro downstream of Thika dam and Treated Water pipeline to Kabete reservoir.

AWSB which is to implement the project on behalf of Gok has contracted GIBB Africa to develop a RAP to mitigate on impact on property.

The project involves Construction of a tunnel from maragua river in Ichichi to Ndakaini(Thika dam). The tunnel will collect water from three rivers within Muranga county namely;Maragua river, Gikigle river and Irati river in proportions of the ratio 3:1:2 respectively according to the size of the respective rivers. The water collected will outpour at Githika river which is an inlet to Thika dam. The water flows to Kogoro treatment plant where it will be treated and flows to Ngethu river which supplies water to Nairobi and its neighbouring towns like Kiambu, Kajiado etc. A map was used to illustrate the description.The project the inlets of the rivers to the tunnel, there will be wiers constructed to prevent back flow of water at the inlets, the sizes of the wiers also vary depending on the size of the river: At Maragua river a wier will be 20m by 5m,at Gikigie river the wier will be 14m by 3.3m and at Irati river it will be 20m by 4.4m. Here some water will overflow to people's lands. Inaddition to this, there will be adit portals which will be used to access the main tunnel.

MIN 3.2014 PROCEDURE FOR THE STUDY

The meeting was briefed on the expected effects from the project ; positive impacts- improvement of infrastructure, employment opportunities, expansion of businesses in the area during and after the project etc. Negative effects- Immorality, Safety and security of the community. The project is expected to affect the environment as well as the people's livelihoods where it will affect land, structures and such like property.

The study will start with public consultation of which this was the first one, followed by surveying which will peg out the exact affected property followed by a census on the specific identified pieces of land. The census is conducted to get the details of the project affected persons(PAPS) and this will help in compensation and resettlement of the PAPS, the requirements for the census were stated including; A copy of ID, A copy of the title deed and other supporting documents for the same. The dates of the census were specified to be 18th Aug to 4th Sep after which no census will be conducted 4th Sep is the cut-off date.

Meetings will also be held with focus groups including men, women and children to find out their specific issues at the various levels. The community was requested to name any features of cultural heritage within the area so as not to be tampered with during construction. The chief gave a rough estimate of the names of the people likely to be affected by the project. Any restrictions on land use will be given by AWSB.

MIN 4.2014.ISSUES

1. The tunnel is approximated to go through Ngacha School, does this mean the school will be relocated?

RESPONSE

- It will not be relocated but in case of any resettlement whatsoever, the right and legal procedure will be adhered to for the same. There will be proper communication on the specific affected parcels after the survey.
2. Is it the client himself that will conduct the compensation process or they will use mediators during the process? Fear of the funds involved being mishandled or mismanaged.
 - No mediators will be given the authority by the client to conduct any activity for either the compensation or other processes during the project. To ensure transparency during the

- process, identification documents will be taken and given to the PAPs in the affected land parcels.
- Only the names on the list to be generated after the survey will be compensated, depending on the calculated costs. The community leaders including chiefs, elders, and headmen will accompany the enumerators for order of work.
3. For the most affected people, is there an estimate of the amount of water that will outflow at Githika river and thus how will this be prevented from causing severe damages?
 - The hydrologist did a study at the proposed outfall site and the land parcels likely to be affected by the overflowing water will hence be compensated for i.e. a buffer zone will be identified.
 4. Will compensation or the process affect farming on the said land parcels?
 - The compensation makes the land parcels to be co-owned by the client and the owner thus any restrictions on the land use will be clarified by the client only after the study but farming is not one of the activities that are likely to be restricted in the area identified.
 5. Is there any wall that will be constructed to prevent backflow of water?
 - No wall will be constructed or erected, there will be proper construction of wier at the outfall area. To prevent soil erosion, gabions will be constructed.
 - There was a suggestion of getting a representative from the area which was noted.
 6. Is it only the enumerated structures and parcels that will be compensated for after the cut-off date?
 - The cut-off date is the determinant of the compensation.

MIN 6.2014 PROPOSALS

The members of the community will meet and discuss on the most appropriate project that will be of benefit to them in line with the proposed project, this is because the projects proposed by AWSB only benefit people downstream leaving out the community upstream. They community should thus be considered because they are the main conservationists of the Aberdare forest which is the source of the rivers in this region.

MIN 6.2014 CLOSING

The meeting ended at 12: 10 with a vote of thanks giving from the area chief who emphasized on the importance of participation from the members of the community as well as appreciating the consulting team for taking their time to inform the community of the proposed project. This was followed by a prayer from a member of the community.

ATTENDANCE REGISTRATION : NTAKONIBOKI LOCATION

| NAME | ID NO. | MOBILE NO. | SIGN |
|-------------------------|----------|------------|-----------|
| Stephen Maina | 22257893 | 0726496639 | <i>SM</i> |
| Peter Mwachira | 8688492 | 0714746685 | <i>P</i> |
| Godfrey Mwachira | 22434738 | 0723164111 | <i>GM</i> |
| Wilson Mwachira Mwangi | 5160421 | 0714941773 | <i>WM</i> |
| Peich Kieruko | 11335412 | 0727467384 | <i>P</i> |
| MARLEI NOKI | 2040395 | 0713663757 | <i>MN</i> |
| MWANGI MAINA | 2040306 | 0736269444 | <i>MM</i> |
| William K Kantau | 2011901 | 0706380896 | <i>WK</i> |
| Johana M Woroje | 7131149 | 0710298392 | <i>JM</i> |
| GERARD M. WANGI | 71386746 | 071014293 | <i>G</i> |
| PHILIP K. MWANGI | 11176797 | 0717278396 | <i>PK</i> |
| JAMES K KAMAU | 3564073 | 0710161979 | <i>JK</i> |
| DAVID KAMAU | 2040017 | | <i>D</i> |
| WILFRED MUKANI | 29342196 | 0722460774 | <i>WM</i> |
| NJOROGE GITONGA | 3336519 | 0716254501 | <i>NG</i> |
| NJOROGE WANJIKU | 2043012 | 0727262350 | <i>NW</i> |
| Wilson Mwachira Mwangi | 0261417 | 0713211367 | <i>WM</i> |
| SAMSON K. WANJIMIA | 8688473 | 0713909485 | <i>SK</i> |
| Danson N. Wakagwa | 1341709 | 0725638777 | <i>DN</i> |
| DORCAS WAMBUI NGANEA | 2045816 | | <i>DC</i> |
| EMMAH WANGARI MUKANGI | 26269921 | | <i>EM</i> |
| JAMES MWANGI NGUNGA | 2043139 | 0723531103 | <i>JM</i> |
| ELISAB WANSIHA KINUTHIA | 22170645 | 0726177649 | <i>EW</i> |
| JOSEPH KARUNGI GIGUSA | 5160532 | 0724277378 | <i>JK</i> |
| ISAAC KIRORI MACHARIA | 13753200 | 0714346112 | <i>IK</i> |
| EDWARD NGACHA GITONGA | 4830313 | 0722648472 | <i>EN</i> |
| JOHN NDIRANGU | 71436455 | 0724825807 | <i>JN</i> |
| BETH MUTHOMI | 17704143 | 0700403972 | <i>BM</i> |
| Mary W. Thuku | 2043980 | 0710100470 | <i>MW</i> |
| Grace Wairimny Kabare | | - | |
| ISAC KAMWEEU | | 0733743050 | |
| WACHIGE MATICH | | | |

**PUBLIC MEETING AT MAIRI- KANGARI LOCATION ON 13-08-
2014**

**MINUTES OF THE PUBLIC MEETING FOR ESIA AND RAP FOR NORTHERN COLLECTOR TUNNEL
PHASE 1 HELD IN MAIRI AT 2: 30 PM ON 13/08/2014**

Attendance, as attached.

MIN 1.2014. INTRODUCTION

The meeting started with a word of prayer from one Mirriam Wangui Mwaniki a member of the community. The chief of the area introduced himself his team where amongst them was the area's assistant commissioner who gave a brief of the purpose of the meeting herein after which he introduced the consulting team to the members of the community and opened the forum for the GIBB AFRICA & AWSB team's introduction.

MICHAEL KABARI WAWERU

Introduced himself as an environmentalist from GIBB AFRICA LTD. This is an international company for consultation, design and management. He explained the role of the company as a field of experts for consultation on different areas including environmental, engineering, water and many others of the kind. The consultation being undertaken is to aid in writing ESIA and RAP reports for the proposed project.

JACOB OMONDI

Introduced himself as a sociologist from GIBB Africa ltd whose work is to study the socio-economic aspects that arise as a result of any project carried out.

Stated that Gibb Africa had been consulted by Athi Water Services Board (a government parastatal) to carry out a study on the Environmental and social effects of a project they proposed on the area. The study will help find out who will be affected by the project (construction of a tunnel from Maragua river to Ndakaini dam)

FLORENCE SIALO

An environmental science student currently on internship at GIBB Africa, to assist and get skills on the project and the ESIA and RAP study.

AWSB TEAM:

DANIEL MBUGUA

Introduced himself as a community development assistant in AWSB and his role is to find out the socio-economic effects of the proposed project to the community here in. AWSB has been tendered by the government to carry out the project and has thus contracted GIBB Africa for consultation on the same for ESIA and RAP study.

EUNICE CHERUTICH

She is an environmentalist in AWSB who's an expert in the field as well as for RAP and ESIA studies.

MIN.2.2014 ... the project

The government of Kenya has received funds from the World Bank for the Water and sanitation Improvement project(WaSSIP) and Agence Francaise De Development (AFD).An Environmental and Social Impact Assessment(ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk

Water Supply to Nairobi city-Northern collector tunnel, a Raw Water Pipeline, Raw Water treatment Works situated at Kigoro downstream of Thika dam and Treated Water pipeline to Kabete reservoir. AWSB which is to implement the project on behalf of Gok has contracted GIBB Africa to develop a RAP to mitigate on impact on property.

The project involves Construction of a tunnel from maragua river in Ichichi to Ndakaini(Thika dam). The tunnel will collect water from three rivers within Muranga county namely;Maragua river, Gikigie river and Irati river in proportions of the ratio 3:1:2 respectively according to the size of the respective rivers. The water collected will outpour at Githika river which is an inlet to Thika dam. The water flows to Kogoro treatment plant where it will be treated and flows to Ngethu river which supplies water to Nairobi and its neighbouring towns like Kiambu, Kajiado etc. A map was used to illustrate the description.The project the inlets of the rivers to the tunnel, there will be wiers constructed to prevent back flow of water at the inlets, the sizes of the wiers also vary depending on the size of the river: At Maragua river a wier will be 20m by 5m,at Gikigie river the wier will be 14m by 3.3m and at Irati river it will be 20m by 4.4m. Here some water will overflow to people's lands. Inaddition to this, there will be adit portals which will be used to access the main tunnel.

MIN 3.2014 PROCEDURE FOR THE STUDY

The meeting was briefed on the expected effects from the project ; positive impacts- improvement of infrastructure, employment opportunities, expansion of businesses in the area during and after the project etc. Negative effects- Immorality, Safety and security of the community. The project is expected to affect the environment as well as the people's livelihoods where it will affect land, structures and such like property.

The study will start with public consultation of which this was the first one, followed by surveying which will peg out the exact affected property followed by a census on the specific identified pieces of land. The census is conducted to get the details of the project affected persons(PAPS) and this will help in compensation and resettlement of the PAPS, the requirements for the census were stated including; A copy of ID, A copy of the title deed and other supporting documents for the same. The dates of the census were specified to be 18th Aug to 4th Sep after which no census will be conducted 4TH Sep is the cut-off date.

Meetings will also be held with focus groups including men, women and children to find out their specific issues at the various levels. The community was requested to name any features of cultural heritage within the area so as not to be tampered with during construction. The chief gave a rough estimate of the names of the people likely to be affected by the project. Any restrictions on land use will be given by AWSB.

MIN 4.2014.ISSUES

1. Wilson Waweru inquired on community benefits and what formula or procedure would be followed during assessment and compensation processes.

RESPONSE

- The proposed water projects were read out as per the suggestions by AWSB which were said to be benefiting the people downstream leaving out people upstream thus the community agreed to discuss on the projects they would like to be assisted in during the construction period.

- After public consultation, the surveyors will visit the proposed site and peg out the affected parcels which will be followed by enumeration and after that compensation and resettlement of the PAPs.
2. Cyrus Mburu Noted that the notification period was not convenient for the sake of landlords who may be living far from this place and are among the PAPs
 - The administration has been communicated to so as to aid in the process and that the chiefs of the area will be informed some days before the census to ensure there will be order during enumeration.
 3. Are people prevented from constructing buildings?
 - Any restrictions on land use activities will be clarified by AWSB.
 4. How will they ensure irrigation benefits the community?
 - The yet to be discussed projects will be considered also the hydrologist did a study previously to find out the level of water safest to be used for the tunnel without compromising alternative uses of the water.
 5. Is the valuer from the government or is it an individual valuer?
 - The valuer is licensed and has met all the requirements for the job to assigned to him.
 6. Is it the area surveyed that the tunnel will pass through or it may shift?
 - The tunnel will definitely pass through the identified area because it will be accurate even from the map of the area.
 7. Suggestion of expansion of Gatundu water project and a proper sewerage drainage system in Kangari.

MIN 5.2014 CLOSING

The meeting ended at 4:20 PM with a vote of thanks giving from the area chief who emphasized on the importance of participation from the members of the community as well as appreciating the consulting team for taking their time to inform the community of the proposed project. This was followed by a prayer from a member of the community.

MAIRI SUBLOCATION.
KANGARI
~~MAIRI~~ LOCATION.

| NAME | ID No | MOBILE NO | SIGN |
|----------------------------|----------|-------------|---------|
| 1 Lucy W. Macharia | 3472485 | 0725531868 | Lucy |
| 2 Ruth W. Kimani | 2040283 | - | Ruth |
| 3 CATHERINE WADJA M. | 13405500 | 0721772126 | C |
| 4 Miriam W. Mwaniki | 2042740 | 0723607766 | Miriam |
| 5 Antony Macharia Kamuny | 3455602 | 0724465746 | antony |
| 6 Obadiah Paulson Ngumbi | 0977406 | 0700903495 | Obadiah |
| 7 Thomas Ngumba Gedeon | 1414850 | 0726669398 | Thomas |
| 8 Stephen Kabugi M | 0972694 | | Stephen |
| 9 Kimani Gidiana | 5160809 | 0724828055 | Kimani |
| 10 /SPAC /MANGA | 24032535 | 07019547 | |
| 11 JOSEPH Wawere | 2043109 | 0710911407 | Joseph |
| 12 MOSES CHEGE KAGENYO | 7167304 | 0716195313 | Moses |
| 13 Francis Mwangi Njoroge | 25786587 | 0721573852 | Francis |
| 14 Hingera John | 10846158 | 0704613329 | John |
| 15 JOHN KAREKI | 11237354 | 072782516 | John |
| 16 Samuel Ndumbi | 24205275 | 0703221973 | Samuel |
| 17 Samuel H. Kurju | 09934665 | 071239135 | Samuel |
| 18 John M. Kimani | 16125598 | 0712983581 | John |
| 19 Justus Karanja Macharia | | 0703133983 | Justus |
| 20 JOEL NJUGUNA G | 2040128 | 0715342148 | Joel |
| 21 Joseph Thiong'o Maminyo | 2040618 | 0723325384 | Joseph |
| 22 Mary Wangiki Mathwa | 2060162 | 0727275954 | Mary |
| 23 Peter Ndirangu Mwangi | 98026097 | 0729897403 | Peter |
| 24 Lucy Wangari Chege | 3564792 | 0717353180 | Lucy |
| 25 Abie W. Chege | 6549911 | 0726992825 | Abie |
| 26 Mary Wangiri | 11105649 | 072861172 | Mary |
| 27 Francis Maina Mwangi | 1878290 | 0722581332 | Francis |
| 28 Lucy Njeri Kabugi | | | Lucy |
| 29 Joseph Kabugi Moinu | 21971405 | 0711-805187 | Joseph |
| 30 Pius Kamau Njome | 3694637 | 072986572 | Pius |
| 31 Simon Ndumbi Muthia | 2890480 | 0778700247 | Simon |
| 32 Edward Mwangi Chege | 2017571 | 0728138610 | Edward |

MOBILE MARI-KANGARI LOCATION

15/04/14

| NAME | ID No | MOBILE No | SIGN |
|--------------------------|----------|-------------|------|
| Peter Nene | 1815140 | 0701344402 | |
| MUCINA | | | |
| KARIMI NJOROGE | 4813363 | 0719193536 | |
| FRANCIS KIHARA MWANGI | 27876242 | 0723577252 | |
| ICAC KASUKU KAGENDO | 10846160 | 0724946755 | |
| JAMES KIHARA MWANGI | 23002496 | 0722985822 | |
| Lukas Kumanikaruki | 1521645 | 0722935280 | |
| SAMSON KAMAU KURIA | 22006700 | - | |
| JAMES Chege | - | 0710306527 | |
| JOHAM M. MUNYUA | 0214564 | 0721287573 | |
| DAVID MACHARIA MURICA | 12636999 | 0713277293 | |
| SAMUEL NJANGIA | 22886526 | 0724932005 | |
| Peter Mwangi | 3466097 | 0726898568 | |
| ROBERT NDURI CHEGE | 11510491 | 0716045289 | |
| DAVID GICHANE | 25567523 | 0700399874 | |
| FRANCIS KIMUTHIA | 8603142 | 0726332692 | |
| JOSEPH WAGETHONA KIBOCHA | 20248376 | 0726580580 | |
| JAMES GICHITHA | 7426988 | 0713639349 | |
| Peter Njoro M | 1133970 | 0702697176 | |
| Chege Mucina | | | |
| Tulius Gituya Kagendo | 3467675 | 0701839417 | |
| ANDREKI NGUMBA MWANGI | 23367907 | - | |
| DAVID M KARANJA | 14652053 | 0704483181 | |
| PETER M MWANGI | 23809842 | 0719706871 | |
| David G. Mwangi | 2042712 | 0711196015 | |
| Samuel Ndurang'i | 2040263 | 0727-032832 | |
| JOHAN GITUMUA | 21198566 | 0723472303 | |
| Muriu Gichara | 2042770 | 0710-106244 | |
| KIEBSTER KIMARI | 29044977 | 0705716230 | |
| Mwangi H Karanja | 11746005 | 0734776963 | |
| Michael Kihara | 14490038 | | |
| Stephan Mwangi | 8517618 | 0717717543 | |

31/09/14. ATTENDANCE LIST - PUBLIC MEETING
 MAIRI - KANGARI LOCATION

| NAME | ID NO | MOBILE NO. | SIGN. |
|------------------------------|----------|------------|-------|
| Joshua Njoroge Njirumui | 11408355 | 0719789595 | |
| Paul Maina Muchira | 13460820 | 0711323883 | |
| David Kihara | 10269717 | 0788692239 | |
| John Mwangi | | | |
| FRANCIS M. MBURUA | 2040567 | 0726730690 | |
| Cyrus Mburua | 0925264 | 0720036263 | |
| F. CHIEF - DORIS W. MUCHEMI | 14570892 | 0727677693 | |
| . CHIEF - SIMON M. KARIUKI | 10849219 | 0726699945 | |
| - KANGARI - CHARLES M. MUHOI | 3606531 | 0722400705 | |

PUBLIC MEETING AT KINYONA LOCATION ON 14-08-2014

**MINUTES OF THE PUBLIC MEETING FOR ESIA AND RAP FOR NORTHERN COLLECTOR TUNNEL
PHASE 1 HELD AT KINYONA AT THE HEALTH DISPENSARY AT 11:20 AM ON 14/08/2014**

Attendance, as attached.

MIN 1.2014. INTRODUCTION

The assistant chief of the area-Michael N. Gitonga noted that some landlords could not make it to the meeting. This was followed by introduction of the people present for the meeting. Some of the landowners were noted to be deceased but were represented by members of their families present. HE invited the chief of Kinyona location who noted that he had only invited the affected people to the meeting and requested the consulting team to take charge and conduct the meeting.

MICHAEL KABARI WAWERU

Introduced himself as an environmentalist from GIBB AFRICA LTD. Which is an international company for consultation, design and management. He explained the role of the company as a field of experts for consultation on different areas including environmental, engineering, water and many others of the kind. The study being undertaken included a team of experts including Hydrologists, Ecologists and Geotechnicians. He also noted that before commencement of any project EMCA warrants prior informed consent through public and stakeholder consultation.

JACOB OMONDI

Introduced himself as a sociologist from GIBB Africa ltd whose work is to study the socio-economic aspect that arise as a result of any project carried out.

Stated that Gibb Africa had been consulted by Athi Water Services Board(a government parastatal) to carry out a study on the Environmental and social effects of a project they proposed or the area. The study will help find out who will be affected by the project(construction of a tunnel from Maragua river to Ndakaini dam).

FLORENCE SIALO

An environmental science student currently on internship at GIBB Africa, to assist and get skills on the project and the ESIA and RAP study

MIN.2.2014 ... the project

The government of Kenya has received funds from the World Bank for the Water and sanitation Improvement project(WaSSIP) and Agence Francaise De Development (AFD).An Environmental and Social Impact Assessment(ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi city-Northern collector tunnel, a Raw Water Pipeline, Raw Water treatment Works situated at Kigoro downstream of Thika dam and Treated Water pipeline to Kabete reservoir. AWSB which is to implement the project on behalf of Gok has contracted GIBB Africa to develop a RAP to mitigate on impact on property.

The project involves Construction of a tunnel from maragua river in Ichichi to Ndakaini(Thika dam). The tunnel will collect water from three rivers within Muranga county namely;Maragua river, Gikigie river and Irati river in proportions of the ratio 3:1:2 respectively according to the size of the respective rivers. The water collected will outpour at Githika river which is an inlet to Thika dam. The water flows to Kogoro treatment plant where it will be treated and flows to Ngethu river which supplies water to Nairobi and its

neighbouring towns like Kiambu, Kajlado etc. A map was used to illustrate the description. The project the inlets of the rivers to the tunnel, there will be wiers constructed to prevent back flow of water at the inlets, the sizes of the wiers also vary depending on the size of the river: At Maragua river a wier will be 20m by 5m, at Gikigie river the wier will be 14m by 3.3m and at Irati river it will be 20m by 4.4m. Here some water will overflow to people's lands. In addition to this, there will be adit portals which will be used to access the main tunnel.

MIN 3.2014 PROCEDURE FOR THE STUDY

The meeting was briefed on the expected effects from the project ; positive impacts- improvement of infrastructure, employment opportunities, expansion of businesses in the area during and after the project etc. Negative effects- Immorality, Safety and security of the community. The project is expected to affect the environment as well as the people's livelihoods where it will affect land, structures and such like property.

The study will start with public consultation of which this was the first one, followed by surveying which will peg out the exact affected property followed by a census on the specific identified pieces of land. The census is conducted to get the details of the project affected persons (PAPS) and this will help in compensation and resettlement of the PAPS, the requirements for the census were stated including; A copy of ID, A copy of the title deed and other supporting documents for the same. The dates of the census were specified to be 18th Aug to 4th Sep after which no census will be conducted 4th Sep is the cut-off date.

Meetings will also be held with focus groups including men, women and children to find out their specific issues at the various levels. The community was requested to name any features of cultural heritage within the area so as not to be tampered with during construction. The chief gave a rough estimate of the names of the people likely to be affected by the project. Any restrictions on land use will be given by AWSB.

MIN 4.2014.ISSUES

1. Will people living on top of the pipeline be forced to move?
During previous projects the community developed water network from the forest. But after usage they were forced to pay for it, they do not trust the government.
 - The easement will lead to a co-ownership of the area. But it is proposed that the area is acquired for a controlled development, as in some activities will not be allowed in case there will be any movement, compensation and resettlement will be conducted orderly.
 - There are provisions in the ESMP for the same.
2. How will the roads be taken care of during construction if they happen to be destroyed?
 - The contractor will ensure the roads are maintained in proper condition.
3. The community initially knew that a dam will be constructed. Therefore, will the dam be constructed along with the tunnel?
 - No, the tunnel has taken place of the dam due to greater impacts that would have rose due to construction of the dam, it was also so costly to construct the dam.
4. Increase in diseases will be witnessed in the area during and after construction thus suggestion of expansion of the existing Kinyona dispensary, to upgrade it and increase supplies to mitigate these, the laboratory, fencing the hospital, maternity services and drug supply.

NOTE : The PAPS will be given a survey ID after the survey

5. The community needs to be assisted through other projects as they are not going to benefit from the water project, these projects include; Completion of Bishop Gatimu Kinyona Girls secondary school, proposal of electricity to be provided.
6. How will the contractor be protected from accidents and may be death?
 - Records of people working will be taken and PPE's must be provided.
 - Insurance will be provided as in the law.
7. How will the project ensure that all those affected are compensated?
 - It was communicated that compensation will be paid to everyone after a decision has been taken by AWSB.

PROPOSALS

- A. To access Ichichi, Mununga, Kinyona there are four routes;
 - Kangari- Kinyona
 - Kariga- Gachochi- Kamukabi-Muranga.
 - Karinga-Gakondo-Kinyona
 - Njiris-Kangema.

Requested for development of these roads, it was noted that this is a direct correlation on roads and livelihoods in the area. This is because they use roads to deliver water.

- B. Noted that during construction, there needs to be a percentage of* allocation.
- C. Assisting the hospital through supplies or upgrade.

MIN 5.2014 CLOSING









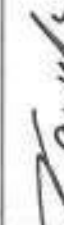

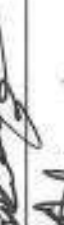


The chief thanked the members of his community for their commitment and response to the call despite a short notice time and also for their participation throughout the meeting. He also thanked the consulting team for the information provided. He requested for the roads to be constructed before commencement of the project. Requested to use the cut-to spoil on improvement of the roads. The meeting ended 1.30 pm with a prayer from a member of the community.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION KINYONA.....

DATE 14/08/14.....

DISTRICT Kisumu.....

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|---------------------------|-----------|---------------|-------------|---|
| SAMUEL BUKODAN MWANGI | 2040223 | CHIEF-KINYONA | 0739-646647 |  |
| PETER KAGUNDU GAACI | 1910474 | KINYONA | 0713377708 |  |
| JOHN KAMAU MWANGI | 5473014 | KINYONA | 0726620317 |  |
| BENSON GICHIMU KIMOTHO | 16077995 | KINYONA | 0712861823 |  |
| CYRUS KURIA IAERI | 21081054 | KINTONA | 0723786263 |  |
| HEZRON ROBERTS KURIA | 0578614 | KINYONA | 072561987 |  |
| JAMES ROBERTS KURIA | 0268684 | KINYONA | 0715727166 |  |
| MICHAEL N. GITONGA | 1995046 | ASS/CHIEF | 0725369680 |  |
| FRANCIS L. KARUMU NDIRAMU | 2041723 | KINYONA | 0714340955 |  |
| JAMES MICHAEL CHEGE | 2042521 | KINYONA | 0712132499 |  |
| DAVID N. NJIRI | 2040619 | VILLAGE ELDER | 0707130441 |  |
| JASON KIBUNAH ROBERTS | 0141778 | KINYONA | 0712809080 |  |
| HENRY MAIMA THAO | 13510496 | KINYONA | 0712832738 |  |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION

DATE

DISTRICT

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|--------------------------|-----------|----------------|--------------|--------------------|
| FREDRICK MWANGI KIMITHIU | 3331271 | KINYONA | 0716591326 | <i>[Signature]</i> |
| DBADIA KARUKI KIMOIRO | 9822629 | KINTONA | 0723426517 | <i>[Signature]</i> |
| CHARLES MWANGI KANUKI | 13274815 | ELDER | 0728014465 | <i>[Signature]</i> |
| SPANSON MACHARIA JIMOTO | 5769849 | KINYONA | 07189336890 | <i>[Signature]</i> |
| ISABEL WAMBUI WARIINGI | 22540336 | KINYONA | 0727456770 | <i>[Signature]</i> |
| JOSEPHINE KANGECHI NGIRI | 24387033 | KINYONA | 0711311018 | <i>[Signature]</i> |
| DICKENS N. NGUNGU GIKEN | 22050294 | KINYONA H/COMF | 0721443106 | <i>[Signature]</i> |
| CHEGE MUTEMA | 0996926 | KINTONA | 0733500637 | <i>[Signature]</i> |
| DANIEL MBUGUA | 11669547 | KINYONA | 0713404151 | <i>[Signature]</i> |
| JAMES NJIRGI | 28643235 | KINYONA | 0703971997 | <i>[Signature]</i> |
| EVANS CHERUTICH | 23102663 | KINI WATA | 0721-772120 | <i>[Signature]</i> |
| FLORENCE UTOUKUO | 38641965 | GIBB ABUJA | 0714 356 712 | <i>[Signature]</i> |

PUBLIC MEETING AT GACHARAGE LOCATION ON 14-08-2014

**MINUTES OF THE PUBLIC MEETING FOR ESIA AND RAP FOR NORTHERN COLLECTOR TUNNEL
PHASE 1 HELD AT GIKIGIE PIMARY SCHOOL FOR MUNUNGA, GACHARAGE AND GIKOE AT
2.20PM ON 14/08/2014**

Attendance, as attached.

MIN 1. 2014. INTRODUCTION

The chief of the area introduced the school's chairman and thanked him for giving a venue appropriate for the meeting after which he handed the meeting over to the consulting team.

MICHAEL KABARI WAWERU

Introduced himself as an environmentalist from GIBB AFRICA LTD. Which is an international company for consultation, design and management. He explained the role of the company as a field of experts for consultation on different areas including environmental, engineering, water and many others of the kind. The study was being undertaken to ensure the project was in line with guidelines provided by EMCA for any proposed project.

JACOB OMONDI

Introduced himself as a sociologist from GIBB Africa ltd whose work is to study the socio-economic aspect that arise as a result of any project carried out.

Stated that Gibb Africa had been consulted by Athi Water Services Board(a government parastatal) to carry out a study on the Environmental and social effects of a project they proposed or the area. The study will help find out who will be affected by the project(construction of a tunnel from Maragua river to Ndakaini dam)

FLORENCE SIALO

An environmental science student currently on internship at GIBB Africa, to assist and get skills on the project and the ESIA and RAP study.

AWSB TEAM:

DANIEL MBUGUA

Introduced himself as a community development assistant in AWSB and his role is to find out the socio-economic effects of the proposed project to the community here in. AWSB has been tendered by the government to carry out the project and has thus contracted GIBB Africa for consultation on the same for ESIA and RAP study.

EUNICE CHERUTICH

She is an environmentalist in AWSB who's an expert in the field as well as for RAP and ESIA studies.

MIN.2.2014 ... the project

The government of Kenya has received funds from the World Bank for the Water and sanitation Improvement project (WaSSIP) and Agence Francaise De Development (AFD).An Environmental and

Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi city-Northern collector tunnel, a Raw Water Pipeline, Raw Water treatment Works situated at Kigoro downstream of Thika dam and Treated Water pipeline to Kabete reservoir. AWSB which is to implement the project on behalf of Gok has contracted GIBB Africa to develop a RAP to mitigate on impact on property.

The project involves Construction of a tunnel from maragua river in Ichichi to Ndakaini(Thika dam). The tunnel will collect water from three rivers within Muranga county namely;Maragua river, Gikigie river and Irati river in proportions of the ratio 3:1:2 respectively according to the size of the respective rivers. The water collected will outpour at Githika river which is an inlet to Thika dam. The water flows to Kogoro treatment plant where it will be treated and flows to Ngethu river which supplies water to Nairobi and its neighbouring towns like Kiambu, Kajiado etc. A map was used to illustrate the description.The project the inlets of the rivers to the tunnel, there will be wiers constructed to prevent back flow of water at the inlets, the sizes of the wiers also vary depending on the size of the river: At Maragua river a wier will be 20m by 5m,at Gikigie river the wier will be 14m by 3.3m and at Irati river it will be 20m by 4.4m. Here some water will overflow to people's lands. Inaddition to this, there will be adit portals which will be used to access the main tunnel.

MIN 3.2014 PROCEDURE FOR THE STUDY

The meeting was briefed on the expected effects from the project ; positive impacts- improvement of infrastructure, employment opportunities, expansion of businesses in the area during and after the project etc. Negative effects- Immorality, Safety and security of the community. The project is expected to affect the environment as well as the people's livelihoods where it will affect land, structures and such like property.

The study will start with public consultation of which this was the first one, followed by surveying which will peg out the exact affected property followed by a census on the specific identified pieces of land. The census is conducted to get the details of the project affected persons(PAPS) and this will help in compensation and resettlement of the PAPS, the requirements for the census were stated including; A copy of ID, A copy of the title deed and other supporting documents for the same. The dates of the census were specified to be 18th Aug to 4th Sep after which no census will be conducted 4th Sep is the cut-off date.

Meetings will also be held with focus groups including men, women and children to find out their specific issues at the various levels. The community was requested to name any features of cultural heritage within the area so as not to be tampered with during construction. The chief gave a rough estimate of the names of the people likely to be affected by the project. Any restrictions on land use will be given by AWSB.

MIN 4.2014.ISSUES

1. If the parent is the holder of the title deed and has not subdivided the land to children who have built houses on the land, who has the right to be compensated?

RESPONSE

- The holder of the title deed is the one to be compensated; however any arrangements for the same should be conducted with involvement of the chief for legal procedure on the issues.
2. Is there a map showing land that is going to be acquired?

- A map will be developed as the census is being done.
 - A map has been acquired and project will be overlaid on it to show affected person.
3. I have a small/ young wood; will these be accessed as mature or young?
- Will be accessed as is.
4. Compensation procedure-directed to AWSB?
- Compensation will follow valuation for the actual calculated amounts for the affected property.
5. In case a school is affected or buildings in that case?
- The buildings will be moved before the commencement of the project.
6. Asked that they are supplying water to Nairobi but how will they benefit?
- Proposed projects: - Piped water to the local community.
 - Road network within the project should be tarmacked.
 - Health Centre with facilities for admission.
 - Existing roads – Gikoe 12-15 km
 - Kangari 20 km.
 - Mununga dispensary- maternity.

MIN 5.2014 CLOSING

The chief thanked the members of his community for their response. He also requested for their cooperation during the census as well as throughout the project. He also noted that the meeting was fruitful by informing the community on the basis of the project. The meeting ended at 16.00 pm with a prayer from a member of the community.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION GIKIGIE, KIRURUA, SICHWA

DATE 14/08/14

DISTRICT MURUNGA, GICHERAGE AND GIKOE

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|------------------------|-----------|---------|------------|-----------|
| Naomi Njoni Githi Kiro | 204237 | Irati | 0702162000 | AAAU |
| ALICE MUTHCHI NJUGUNA | 7911545 | GIKIGIE | 0715701622 | AAAU |
| PAUL WANJAU MUCHEU | 32798311 | MARUNGI | 0711901738 | AAAU |
| BENSON KARANGA MWANGI | 3353621 | GIKIGIE | 071154517 | AAAU |
| RUTH WANJAU KATHU | 2043189 | IRATI | 0715406522 | AAAU |
| JOSEPH MWANGI KIRARIE | 0312709 | MARUNGI | 0718262630 | AAAU |
| BONIFACE IRUNGU GITHI | 7556658 | GIKIGIE | 0724636027 | AAAU |
| BEN WAWERY MUCERY | 6112054 | MARUNGI | 6112054 | AAAU |
| RUTH WACHUKA MBICHU | 2044452 | GIKIGIE | N/A | AAAU |
| TERESIA WAIBINYUKI | 3732510 | GIKIGIE | 071134986 | AAAU |
| MARGRETI MAC MAINA | 3237291 | GIKIGIE | 0700947611 | AAAU |
| SETH KIRIGOM KUAIN | 21728348 | GIKIGIE | 072251157 | AAAU |
| SAMUEL NBUGI GICHTU | 7422080 | IRATI | 0725463320 | AAAU |
| Peter Mwangi Gibogo | 11082070 | MARUNGI | 0726700639 | AAAU |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION ATHI W.S.S. PRIMARY SCHOOL

DATE 14/08/14

DISTRICT MUNUNGA GACHARAGE
AND GICOD LOCATIONS

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|---------------------------|-----------|------------|------------|--------------------|
| SAMUEL MURRYA HAMAU | 12484720 | MUCHAGATHA | 0725488717 | <i>[Signature]</i> |
| PETER BEN WANERU | 10489727 | MAIRUNGI | 0723150246 | <i>[Signature]</i> |
| JOSEPH KAMAU WANERU | 11373162 | MAIRUNGI | 0703034474 | <i>[Signature]</i> |
| David Muecai Kamau | 3702306 | Muchagatha | 0714312538 | <i>[Signature]</i> |
| John Kago Njui | 0783551 | Mungovoku | 0710655994 | <i>[Signature]</i> |
| JAMES MWANU HAMAU | 0412963 | MUCHAGATHA | 0716194695 | <i>[Signature]</i> |
| SAMUEL MUCHERU BEN | 9948994 | MATRUNGI | 0711901738 | <i>[Signature]</i> |
| PETER HARINY MUOH | 0710516 | MUNTOROKU | 0738453147 | <i>[Signature]</i> |
| MARTIN XINIO CHEGE | 29057010 | Mungovoku | 0712315039 | <i>[Signature]</i> |
| FLORENCE WIRIUKU KURIA | 3732384 | MUCHAGATHA | 0715717530 | <i>[Signature]</i> |
| Betty Wambui Gichuaji | 3564937 | MUCHAGATHA | 0714114474 | <i>[Signature]</i> |
| Eric John Gichaga | | IRATI | 0707079702 | <i>[Signature]</i> |
| Eutychnus Matthew Gichuhi | 4545595 | IRATI | 0721397430 | <i>[Signature]</i> |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

LOCATION Gikisisi Primary School

DATE 14/08/14

DISTRICT

| NAME | ID NUMBER | VILLAGE | MOBILE NO. | SIGNATURE |
|---------------------|--------------------------------|---------------------------|-------------|---------------|
| DANIEL MBUGUA | 11862547 | AWSB | 0713404151 | <i>Dan.</i> |
| Eunice Chemich | 23102663 | Athi water | 0721-712120 | <i>EC</i> |
| JAMES NIAGI | 28643255 | Athi water | 0703971997 | <i>JA</i> |
| FLORENCE C TOOKUO | 28541965 | GIBB | 0714396712 | <i>FT</i> |
| JOHN MANA GISEON | 10933086 | CHIEF - INTERIOR MINISTRY | 0714114495 | <i>John</i> |
| JACOB OMONDI GIONDO | SOCIOLOGIST GIBB AFRICA LTD | GIBB Africa Ltd | 0721271816 | <i>JG</i> |
| NELSON MURERA MANA | 16039238 | Munyoro | 0729583578 | <i>Nelson</i> |
| PETER MWAIBURA | 2042287 | GIKISISI PRY. | 0714041314 | <i>Peter</i> |
| | | | | |
| | | | | |
| | | | | |
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APPENDIX VI-II: STAKEHOLDER CONSULTATION FORMS AND NOTES TO MEETINGS

1. Introductory letter from Athi Water Services Board
2. Stakeholder consultations with Fisheries officer Kangema Sub County
3. Stakeholder consultations with Livestock officer, Kangema Sub County
4. Stakeholder consultations with Agricultural officer, Kangema Sub County
5. Stakeholder consultations Public Health Officer, Kangema Sub County
6. Stakeholder consultations with Gender and Social Development officer, Kangema Sub County
7. Stakeholder consultations with Assistant County Commissioner, Kangema Sub County
8. Stakeholder consultations with Forestry Officer, Kangema Sub County
9. Stakeholder consultations with Public health officer, Kigumo Sub County
10. Stakeholder consultations with Water Officer, Kigumo Sub County
11. Stakeholder consultations with the Water Resources management Authority Officers- Muranga Sub Region
12. Stakeholder consultations with Social development Officer, Kigumo Sub County
13. Stakeholder consultations with Fisheries officer, Kigumo Sub County
14. Stakeholder consultations with Forestry officer, Kigumo Sub County
15. Stakeholder consultations with Lands Officer, Muranga County

16. Stakeholder consultations with Agricultural Officer, Kigumo Sub County
17. Stakeholder consultations with Physical Planning Officer, Muranga County
18. Stakeholder consultations with County Director NEMA, Muranga County
19. Stakeholder consultations with Livestock Officer, Kigumo Sub County
20. Stakeholder consultations with Makomboki Tea Factory Officer, KTDA
21. Stakeholder consultations with Managing Director MUWASCO
22. Stakeholder consultations with Technical Manager, Kahuti/ Gatamathi WSCo
23. Stakeholder consultations with Technical Ass. Manager, Muranga South WSCo
24. Stakeholder consultations with Maragua Water Resources Users Association
25. Stakeholder consultations minutes for meeting held at Wanjii Hydro Power Station (KenGen)
26. Stakeholder consultations with Tana Water Services Board
27. Stakeholder consultations with Mavoko WASCo
28. Stakeholder consultations with Kiambu WASCo
29. Stakeholder consultations with Ruiru- Juja WASCo
30. Notes to meeting with various stakeholders for meeting held in County Commissioner's Office, Muranga County
31. Stakeholder consultations with Karuri WASCo
32. Stakeholder consultations with Kikuyu Water Company
33. Stakeholder consultations with Ololaiser WASCo

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Athi Water Services Board
Upper Hill
Africa Re-Centre, Hospital Road
P.O. Box 45283 - 00100, Nairobi
Tel: +254 -020- 2724292/3, 2727438/441/442/440



Our ref: AWSB/WASSIP AF/COMP. 1/CS-03/2012

23rd July 2014

TO WHOM IT MAY CONCERN

Dear Sir / Madam,

**ENVIRONMENTAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN
FOR NORTHERN COLLECTOR TUNNEL PHASE 1 AND THIKA-NGORONGO-
KABETE PIPELINES**

LETTER OF INTRODUCTION OF M/S GIBB AFRICA LIMITED

The Government of Kenya has received funds from the World Bank for the Water and Sanitation Services Improvement Project (WaSSIP) and from the Agence Française de Development (AFD).

Athi Water Services Board (AWSB) intends to use part of these proceeds to undertake Detailed Design Studies for the Northern Collector Tunnel Phase 1, Thika – Kigoro raw water pipelines and Kigoro- Ngethu treated water pipelines. The project will be designed to draw 120,900m³/day of water from Maragua, Gikigie and Irati Rivers in Muranga County and channel it to Thika Dam. The main objective of this project is to increase water supply to Nairobi City.

AWSB has also commissioned GIBB Africa Ltd, a firm of experts registered by the National Environment Management Authority (NEMA), to conduct Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) for the Project.

This letter is therefore to kindly request you to accord them maximum cooperation and provide them with the necessary information which they may request from your organization. This will aid them in the preparation of the ESIA and RAP reports.

We will highly appreciate any assistance accorded to the Consultant. Should you require any information/clarification, please do not hesitate to contact Eng. John M. Muiruri by email jmuiruri@awsboard.go.ke or at Athi Water Service Board address and telephone numbers above.

Yours faithfully

A handwritten signature in black ink, appearing to read 'M. Milgo', is written over a faint circular stamp.

**ENG. MALAQUEN MILGO
CHIEF EXECUTIVE OFFICER**

5-08-2014. NOTES TO MEETING WITH FISHERIES OFFICER
KANGEMA SUB-COUNTY, MURANGA COUNTY.

PRESENT:

KANGEMA

- ① MS. VERONICA W. GATHUMBI - FISHERIES EXTENSION OFFICER.
- ① MICHAEL KABARI W - ENVIRONMENTALIST - GIBB AFRICA

COMMENTS:

- # Fisheries department in Kangema sub-county focuses their operations on Mathioya River and Kayahwe River. From the proposed project the farmers (fishermen) will be most affected, especially those that use Maragwa River downstream of the intake.
- # Mitigation measures should be put in place as from the design stage so as to ensure that the fish spp that swim downstream are not affected.
- # In Mathioya River there are private farmers that are given permits by our office to breed Trout fish. Most farmers keep fish for commercial purposes as well as leisure fishing.
- # Most spp are in sensitive habitat (such as the Trout fish) that are sensitive to pollution/aeration that is caused by siltation due to activities up stream. There is a company called Fry Fishers Company in Kangema that breed trout fish for leisure. They are licensed & have a permit.
- # The other species that are found in the area is Cat Fish spp. that have very good adaptive character, meaning they can survive in polluted waters.
- # Fry fishers Company have a given length along the Mathioya River where they are permitted to fish. The area is as from Kanyanyini Factory up to Abardanes Forest.

The company has a camp (recreational) area where tourists come & fish for fun. They camp there during the holidays. The camp is in Tutuo near the centre (market). The area can be accessed through the Kangema - Komyanyaini - Tutuo Road.

SPECIES IN THE AREA:

- ① Trout Fish - ① Fresh water River Mathiyoja & Maragna. They require cold temperature 13°C & below (usually close to the forest edge).
- ① Cat fish - ① Can survive anywhere and usually live in muddy areas of deep ^{calm} or shallow ^{areas} of the river.
- ① Tilapia - ① usually by farmers. Its sensitive to Aeration.
 - ① Farmers divert rivers to some their ponds & at this end the Tilapia & cat fish swim up stream or down into the River.

The farmers and groups of fish farmers in the area can be women groups; individual (private farmers), youth groups and institutions such as schools. Some of the groups are:

- ① Kirwa Youth Groups - farming Trout & Tilapia.
- ① Ngeoro Y. Group - Tilapia.
- ① Nyaga tundu High school - with 2 fish ponds;
- ① Nyaga tundu Pri. school - with 2 fish ponds;
- ① Kihunya sec. school - with 1 fish pond;
- ① Kihunya Pri. school - 1 fish pond;
- ① Kiya wabogo Pri/sec school - 2 F. ponds each.
- ① Tutuo Pri. school - 1 F. pond (not stocked)
- ① Karuri Gatware High school - 1 F.P. (not stocked)
- ① Yego Primary school - 1 F. Pond.
- ① Wanjerere Pri. School - 1 F. Pond.

- # These institutions get their inputs from Government thro' extension services. The fish farming practice was started as a Government's stimulus (Economic). Initiatives were aimed at promoting food security, fish farming education and source of income.
- # Markets from farming are mostly local with demand for fish being high and the supply being low within Kangema constituency. There are various markets within towns such as Kangema & Kigumo. Most traders selling Nile perch & Tilapia. Some of the markets are: Misumu Ndogo in Grakira, Ugingo & Kingfisher in Kangema Township.
- # The uptake of fish is good though the challenge is funding to start up the ponds. Previously the Government funded the start ups in the ESP.
- # In Kangema there are 150 private farmers that are offered extension services by the ~~Min.~~ Dept. of Department of Fisheries & 325 ESP farmers both individuals & institutions.
- # The department gives advice on how to construct fish ponds & maintain them. Some of the extension services include: Farm visits, Follow ups, education on pond management & hygiene. Fingerlings are bought from individual or group/institution investment.

NOTES PREPARED BY: MICHAEL KABARI W.
 ENVIRONMENTALIST
 GIBB AFRICA LTD.

05-08-2014.

CONFIRMED BY: VERONICA WANJERI GITTHOMBI
 SIGNATURE / DATE.

SEE OVERLEAF.
 - - - PAGE -

Stakeholder Contacts:

| | | | |
|--------------------------------|--|---------|---------|
| Name: | VERONICA WANJERI GATHUMBI | | |
| Contacts: | Tel: | Mobile: | e-mail: |
| Organization Represented: | FISHERIES DEPT. 0727-921249 Veronica.wanjeri@yodha.com | | |
| Designation: | FISHERIES EXTENSION OFFICER | | |
| Locality: | KANGEMA | | |
| Date: | 5 th AUGUST 2014 | | |
| Signature: |  | | |
| Official Stamp: (if available) |  | | |

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT
ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1**

STAKEHOLDER CONSULTATION GUIDE

DISTRICT AGRICULTURE AND LIVESTOCK DEVELOPMENT OFFICER - KANGEMA

Introduction

The Government of Kenya has received funds from the World Bank and Agence Française de Développement (AFD) for the Water and Sanitation Improvement Project (WaSSIP). An Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, Downstream Works, a Raw Water Pipeline, Raw Water Treatment Works situated 6km Downstream of Thika dam and Treated Water Pipeline to Kabete Reservoir. To achieve this AWSB which is to implement the project on behalf of GoK has contracted GIBB Africa to develop ESIA & RAP to mitigate on impact on property

The aim of this study is to collect information at household level and from stakeholders for the purposes of impact analysis and development of mitigation measures.

1. What are the land use patterns in the project area?

Farmers are doing dairy keeping, sheep production
Local poultry, bee keeping, dairy goat farming
and fodder production - in addition to tea
production and agroforestry

2. How will change in land use from agriculture to infrastructure development impact the area and the local population?

Minimal - considering the land affected is
a very small portion or percentage

3. Is there any legislation guiding change in land use? If Yes, name and state how it applies to the above named project.

Yes - there is a law - Change of user under
Physical planning act.

The land which is currently under ~~#~~ Agricultural use has to be changed

4. In your opinion what are some of the challenges that livestock rearing households might face with the proposed development in the project area?

- Minimal except in cases where fences will be displaced and move together with their animals.
Water for livestock may not be affected in any significant way.

5. What are women's rights towards ownership to property and land and livestock in your district?

About 20% of ~~the~~ land in Kangema is owned ~~and~~ by women otherwise women have all rights to own land and other properties.

6. Do you foresee any positive impacts from the proposed bulk water tunnel development?
Yes or No, if yes what impacts do you see

i. During construction

Yes.
Provision of jobs and increased economic activities around the tunnel/weirs construction area.

ii. During operation

7. Do you foresee any negative impacts from the proposed bulk water tunnel development?
Yes or No, if yes what impacts do you see
iii. During construction

Yes.

- Uprooting of crops or fodder as the construction is ongoing.
- Pollution of streams and aquatic life.
- Displacement of people in area where the tunnel will pass.

- iv. During operation

- Danger of livestock and small children drowning in the intake reservoirs/weirs

8. If your answer No. 3 is Yes, please suggest how the anticipated negative impacts can be mitigated.


- i. During construction

- Compensation of people being displaced
- Proper disposal of soil, rocks and debris from the tunnel under construction

- ii. During operation

- Fencing off of the intake/weir area to avoid danger of drowning.

Stakeholder Contacts:

| | | | |
|--------------------------------|---|--------------------|-----------------------------|
| Name: | PATRICK KIMYANJUI NJOROGE | | |
| Contacts: | Tel: 0722339908 | Mobile: 0722339908 | e-mail: njorogepk@yahoo.com |
| Organization Represented: | Department of Livestock Production | | |
| Designation: | District Livestock Development Production Officer | | |
| Locality: | Kangema Sub-County | | |
| Date: | 5/8/14 | | |
| Signature: |  | | |
| Official Stamp: (if available) | | | |

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT
ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1**

STAKEHOLDER CONSULTATION GUIDE

SUB COUNTY / DISTRICT AGRICULTURAL OFFICER

Introduction

The Government of Kenya has received funds from the World Bank and Agence Française de Développement (AFD) for the Water and Sanitation Improvement Project (WaSSIP). An Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, Downstream Works, a Raw Water Pipeline, Raw Water Treatment Works situated 6km Downstream of Thika dam and Treated Water Pipeline to Kabete Reservoir. To achieve this AWSB which is to implement the project on behalf of GoK has contracted GIBB Africa to develop ESIA & RAP to mitigate on impact on property

The aim of this study is to collect information at household level and from stakeholders for the purposes of impact analysis and development of mitigation measures.

1. What is the land tenure system in the project area?

Individually owned - freehold

2. What is the land use pattern in the District and specifically in the project area due for land acquisition?

Agricultural - Small scale tea production with small scale
horticultural production lot under small irrigation
projects

3. What are the agricultural practices of the community living in the project area?

Small tea production, small scale horticultural production, vegetables,
Avocados and tree tomatoes, papayas and garden peas

4. Which crops are grown by the community living in the project area?

Tea, garden peas, Avocadoes, Snow peas, Irish potatoes, tree tomatoes

5. What are the market rates according to the Agricultural Office for the above crops and trees found in the project area?

Tea - ~~40~~ 40 per kg
 Garden peas - 50 " "
 Avocadoes - 8 per fruit
 Snow peas - 70 " "
 Irish potatoes - 3000 per 110 kg bag
 Tree tomatoes - 8 per fruit

6. In the current state of agricultural production are there any noticeable health and safety issues? Explain

Minimal.

7. What are women's rights towards ownership to property and land in the Sub-county?

Most of the land is owned by men 98% and only 2% by women via inheritance or deceased husband. But they have right to own land and other property.

8. Do you foresee any negative impacts from the proposed gravity system development?
Yes or No, if yes what impacts do you see

i. During construction

YES - Destruction of crops during construction
- Deep disposal of materials excavation material from the tunnel pit into the water and reduction of land productivity where it is disposed.
- danger of drowning of children and animals at intakes.

ii. During operation

YES - Discharge of untreated sewage into the tunnel due to rock fractures leading to disappearance of the said streams.

9. If your answer No. 8 is Yes, please suggest how the anticipated negative impacts can be mitigated.

i. During construction

- Fencing of the intake weir
- Safe disposal of the excavation material to the surrounding roads.
- Compensation of owners of the land whose crops and livelihood is affected.
- Soil conservation of the sites

ii. During operation

- Ensure minimal vibration during construction to minimize
down fracturing of the rock mass.
- Proper sealing of the rock fractures.

Stakeholder Contacts:

| | | | |
|---------------------------------------|--|----------------|--|
| Name: | FRANCIS NI KIACHIRA | | |
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| Organization Represented: | Min of Agriculture - Murang'i County, | | |
| Designation: | District Agriculture Officer - Kangema | | |
| Locality: | Kangema | | |
| Date: | 05/05/2014 | | |
| Signature: | [Signature] | | |
| Official Stamp: (if available) | | | |

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT
ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1**

STAKEHOLDER CONSULTATION GUIDE

SUB-COUNTY / MEDICAL OFFICER OF HEALTH

Introduction

The Government of Kenya has received funds from the World Bank and Agence Française de Développement (AFD) for the Water and Sanitation Improvement Project (WaSSIP). An Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, Downstream Works, a Raw Water Pipeline, Raw Water Treatment Works situated 6km Downstream of Thika dam and Treated Water Pipeline to Kabete Reservoir. To achieve this AWSB which is to implement the project on behalf of GoK has contracted GIBB Africa to develop ESIA & RAP to mitigate on impact on property

The aim of this study is to collect information at household level and from stakeholders for the purposes of impact analysis and development of mitigation measures.

1. What are the top ten common illnesses within the Sub-county / District specifically the project area that is Kanyenyaini division?

- | | |
|----------------------------|-----------------------------------|
| 1. <u>URTI</u> | 7. <u>Chicken pox</u> |
| 2. <u>Skin disorders</u> | 8. <u>Eye infections</u> |
| 3. <u>Pneumonia</u> | 9. <u>Rheumatism</u> |
| 4. <u>Diarrhoea</u> | 10. <u>Ear infections</u> |
| 5. <u>UTI</u> | (It should be noted that the |
| 6. <u>Normal Accidents</u> | workers will be vulnerable to the |
| | above) |

2. What is the doctor patient ratio in the county / area?

1 : 19,247

* The subcounty has 4 doctors serving a population of 76,988 persons as per 2009 census.

* Ichichoe dispensary has a nurse (1)

* Kanyenyaini Health Center has (2) Clinical Officers

3. What are the HIV/AIDS prevalence rates in Muranga?

5.6% in the Muranga County.

4. What initiatives are in place to mitigate the spread of the above illnesses?

- i. Water treatment at Household level (Aquatach) provided by DPHO officer to the community.
 - ii. Vaccination against typhoid fever
 - iii. Health education on prevention and control by Public Health Officers, Community Health Extension Workers
5. What is the status of HIV / AIDs in the Sub-county / District?

Do not have for subcounty but for entire County at 5.6%.

6. Which is the most vulnerable group to HIV/ AIDs infections?

- a) (1) Youth (12yrs - 24yrs).
- (2) Bowda Bowda operators.

b) Challenge is that the community is not afraid of HIV/AIDs but pregnancies. Therefore uptake of HIV/AIDs preventive measures is low.

7. What health programs does the department have to deal with

- a. HIV/AIDs menace?

1. CAC - Constituency AIDS Control Council under the
the PHD

ii. CCC - Comprehensive Care Center for PLHA.

iii. Multisectoral programs which is involvement of all stakeholders.

(1) Defaulter tracing for
defaulters and treatment.

(2) Advocacy and Health Education on TB.

c. Vaccination

(1) Outreach programs.

(2) Facility Dialogue Days.

8. What is the number of health facilities available in the locality? What are the categories and distribution?

* There are thirteen (13) Health
Facilities:

→ Sub-District Hospital (1)

→ Health Centres (4)

→ Dispensaries (8)

* It was noted that there is one (1) dispensary
in Ichchie the project area.

* The main referral hospital is Maranga
District Hospital.

9. What are the services offered in the health facilities near the project area?

i. Curative services - treatment of diseases.

ii. Promotive services - Enhancement of health status
through advocacy.

iii. Preventive services - Vaccination services.

10. Do you foresee any positive impacts from the proposed Northern Collector Tunnel development?

Yes or No, if yes what impacts do you see

i. During construction

- i. Creation of employment in forms of casual labour.
- ii. Opening up of business opportunities to community members.
- iii. Investors may come in due to opening up the area.

ii. During operation

None.

11. Do you foresee any negative impacts from the proposed Northern Collector Tunnel development?

Yes or No, if yes what impacts do you see

i. During construction

- i. Increase in eye infections due to dust.
- ii. Increase in STIs in the project area.
- iii. Rise in cases of accidents due to increase in vehicular traffic.
- iv. Pollution of water through disposal of waste and oil from construction equipment.
- v. Carving on of the soil due to topography of the project site.
- vi) Noise pollution.

ii. During operation Construction mitigation measures

- i) Regular wetting of the work place
- ii) Provision of condom dispensers at the work site and for the community.
- iii) Provision of enough PPEs to the workers
- iv) Adequate installation of safety signages along the road and work place. eg yellow ribbons. (This should be site specific)
- v) Diling should be done at a site far from water source. Secondly Regular maintenance of equipment to minimize leakage.
- vi) To mitigate on noise it is proposed that works are conducted during the day. And, workers must be

provided with noise reduction gadgets.

12. Negative impacts during operations:
If your answer No. 7 is Yes, please suggest how the anticipated negative impacts can be mitigated.

i. During construction

None present.


ii. During operation Mitigation measures:

1. Proper maintenance of the tunnel

13). Refuse collection

1. This is done by Council of Kangema but only within the town.
- ii. The Kangema Sub-county does not have a landfill site only crude dumping is being used.

Stakeholder Contacts:

| | | | |
|--------------------------------|--|--------------|----------------------|
| Name: | CHARLES W. MWANGI | | |
| Contacts: | Tel: | Mobile: | e-mail: |
| | | 0720 173 519 | charlesw@johi102.org |
| Organization Represented: | PUBLIC HEALTH OFFICE | | |
| Designation: | DISTRICT PUBLIC HEALTH OFFICER | | |
| Locality: | KANGEMA | | |
| Date: | 5/8/2014 | | |
| Signature: |  | | |
| Official Stamp: (if available) | <p>SUB COUNTY PUBLIC HEALTH OFFICER P.O. Box 116, KANGEMA CLEAN HANDS SAVE LIVES</p> | | |

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT
ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1**

STAKEHOLDER CONSULTATION GUIDE

SUB-COUNTY / DISTRICT GENDER AND SOCIAL DEVELOPMENT OFFICER

Introduction

The Government of Kenya has received funds from the World Bank and Agence Française de Développement (AFD) for the Water and Sanitation Improvement Project (WaSSIP). An Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, Downstream Works, a Raw Water Pipeline, Raw Water Treatment Works situated 6km Downstream of Thika dam and Treated Water Pipeline to Kabete Reservoir. To achieve this AWSB which is to implement the project on behalf of GoK has contracted GIBB Africa to develop ESIA & RAP to mitigate on impact on property

The aim of this study is to collect information at household level and from stakeholders for the purposes of impact analysis and development of mitigation measures.

1. What are the NGOs and Community Based Organizations (CBO's) within the project area?

| NGO | CBOs / Self Help Groups |
|---------------|--|
| - Abadi Trust | • Ichichic Disability Self help Group |
| | • Kangema Abadare Focal Deupt Area Committee - Upper Tarna |
| | |
| | |
| | |
| | |
| | |
| | |

2. Which groups are considered vulnerable in the community? (With emphasis on the community around the proposed tunneling project site)

1. Vulnerable people are the landless within Ichichic who depend work / casual labour in tea plantation
2. Persons with disability
3. Orphans living with elderly people

4. Unemployed youth.

3. What are the main social problems in the project area

i. Food insecurity due to heavy dependence on cash crops.

ii. Alcoholism among men

4. What programs do you have in place to solve the above mentioned challenges

i) Programs under Upper Tana Natural Resource management project which geared towards adoption of food crops to improve the community livelihoods

ii) Ministry of Agriculture / Lickitok programs to improve milk production through food provision, Fruit tree adoption programs.

iii) Regulation of times beer and alcohol is sold.

iv) Community initiatives to close down illicit alcohol production points.

5. What economic and social activities are the vulnerable members of the community involved in?

i. Picking of tea.

ii. Provision of other casual labour such as ploughing.

iii) Cash transfers to households headed by the elderly living with orphans.

6. What support or welfare do you have in the project area

i) Cash transfer program.

ii) Upper Tana Natural Resource Management Program.

iii) CDF projects - School renovations & purchases for school going children.

7. What are the socio-cultural norms that guide property ownership specifically Land within the project area.

i. Land is owned by men. Therefore, it is only the men who is in charge of transactions.

ii. Currently women are also inheriting land in the project area.

8. Gender Issues

a) Resource ownership: Indicate sex (M/F)

| Resources | Who buys | Who owns | Who controls | Who uses |
|-------------------------------|----------|----------|--------------|----------|
| Land | M | M | M | M/F |
| Trees and Forest | M | M | M | M/F |
| Livestock | M | M | M | F |
| Crops | M | M | M/F | M/F |
| Household property | F | F | F | M/F |
| Cars motorcycles and bicycles | M | M | M | M/F |

(Females milk, raise and sell produce).

b) Gender roles: Who does the following? (Tick where applicable)

| Activity | Men | Women | Boy | Girls |
|-----------------------|----------|----------|----------|----------|
| Digging | ✓ | ✓ | ✓ | ✓ |
| Cooking | | ✓ | | ✓ |
| Food collection | | ✓ | | ✓ |
| Vegetable collection | | ✓ | ✓ | ✓ |
| Fetching water | | ✓ | | ✓ |
| Washing utensils | | ✓ | | ✓ |
| Collecting firewood | | ✓ | | ✓ |
| Looking after animals | ✓ | | ✓ | |
| Washing clothes | | ✓ | | ✓ |
| Total task | 2 | 8 | 4 | 8 |

9. Are you aware of any site of historical / Archeological importance to the community in the project area?

None in the project

10. Are there NGO's and / or CBOs in the project area? If Yes, Please List them and their roles

11. Do you foresee any negative impacts from the proposed development of the tunnel?

Yes or No, if yes what impacts do you see

i. During construction

i. School dropouts especially on girl child due to
cohabitation with new workers

ii. Teenage pregnancies.

iii. HIV/AIDS increase.

iv. Damage of roads by the construction
activities

ii. During operation Proposals to curb about:

i. Workers should be given breaks during
their work to go home. To reduce chances
of promiscuity leading to teenage pregnancies
and HIV/AIDS.

ii. Repair of roads on a continual basis
during construction.

iii. Awareness creation to workers and community
members, HIV/AIDS testing.

12. If your answer No. 7 is Yes, please suggest how the anticipated negative impacts can be mitigated.

i. During construction

i. Employment and job creation.

ii. Increased sale in crops for farmers

iii. Increased activities related to trading
due to availability of markets.

iv.

ii. During operation Proposals:

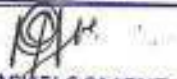

i. Proposed tree planting initiatives by AWCB.
to the community

11. Provision of water for domestic consumption.

13. What are your comments on this exercise?

- ✓ Noted that the consultation with the line ministries departmental heads will go a long way in increasing support.
- ✓ Suggested that in-depth consultation and sensitization of the political class.
- ✓ Proposed for consultation with the community.

Stakeholder Contacts:

| | | | |
|---------------------------------------|---|----------------|---|
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| Contacts: | Tel: 0720711922 | Mobile: | e-mail: joycemugure@gmail.com |
| Organization Represented: | SOCIAL DEVELOPMENT DEPARTMENT | | |
| Designation: | Social Development Officer | | |
| Locality: | Kangema | | |
| Date: | 5/8/2014 | | |
| Signature: |  | | |
| Official Stamp: (if available) |  | | |

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT
ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1**

STAKEHOLDER CONSULTATION GUIDE

DEPUTY COUNTY COMMISSIONER - KANGEMA

Introduction

The Government of Kenya has received funds from the World Bank and Agence Française de Développement (AFD) for the Water and Sanitation Improvement Project (WaSSIP). An Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, Downstream Works, a Raw Water Pipeline, Raw Water Treatment Works situated 6km Downstream of Thika dam and Treated Water Pipeline to Kabete Reservoir. To achieve this AWSB which is to implement the project on behalf of GoK has contracted GIBB Africa to develop ESIA & RAP to mitigate on impact on property

The aim of this study is to collect information at household level and from stakeholders for the purposes of impact analysis and development of mitigation measures.

1. What is the land tenure system in the project area Ichichi and Kiruri locations in Kanyenyaini Division?

Free-hold

2. Has there been any project that required land acquisition through direct purchase or compulsory acquisition by the Government in the District?

YES or NO

- b) If YES was the Sub-county Administration involved

YES or NO

- c) If yes what were the roles played by the administration in the compensation exercise

- information dissemination to the public

- Linkage between government, project team and the public

- Channel for compensation on land acquisition

3. What are or can be challenges the project can face in the Sub-county on issues to deal with?

a) Purchase of land?

- unrealistic values such as overestimation
- Resistance by owners to surrender any portion of land

b) Involuntary displacement of population for infrastructure development

- Resistance to change or the acquisition

4. In your opinion, what is the community perception of the project?

- It is only intended to benefit others outside the county as opposed to benefitting them directly as a start before getting to others.
- compensation should be reasonable

5. What are the settlement and migration patterns in the area? Do you foresee any influx or other wise in the area, if so, Why?

Limited migration and no influx as land parcels are freehold with minimal transfers of ownership.

The climate / weather of the area is extremely cold and therefore very few people are interested in land from the area.

6. What is the procedure of land acquisition within the District through the current constitutional dispensation?

voluntary or direct purchase

7. Do you foresee any positive impacts from the proposed Northern Collector Tunnel development?

Yes or No, if yes what impacts do you see

- i. During construction

- Employment for the youth.

- ii. During operation

- reliable water supply to users / public

8. Do you foresee any negative impacts from the proposed Northern Collector Tunnel development?

Yes or No, if yes what impacts do you see

- iii. During construction

Destruction of roads, farms and the environment

- iv. During operation

- illegal sinking of boreholes near the funnel

9. If your answer No. 8 is Yes, please suggest how the anticipated negative impacts can be mitigated.



i. During construction

- A written MOU between the stakeholders on repairs to the affected roads especially upon completion of the project

ii. During operation

- An MOU still to establish non-interference with the funnel by the stakeholders especially the public near it.

Stakeholder Contacts:

| | | | |
|--------------------------------|---|---------|---------|
| Name: | MIRIAM WANGARI TILAS | | |
| Contacts: | Tel: | Mobile: | e-mail: |
| Organization Represented: | D.O.P (DCC's office) | | |
| Designation: | Assistant County Commissioner | | |
| Locality: | Kangema | | |
| Date: | 6/8/2014 | | |
| Signature: |  | | |
| Official Stamp: (if available) |  | | |

KENYA FOREST SERVICE (KARUMBA)

- Tree species in the area — Eucalyptus spp., Grevillea robusta, Acacia mearnsii, Pinus patula and Cupressus lusitanica which are mainly geared towards meeting local need such as construction, firewood and charcoal. Indigenous tree species include Croton macrostachyus, Tarbalemonia ^{Mitundu} stapfiana, Macaranga kili-mandscharica (Mierera, ^{Mitundu} Miki-hakuba)
- Land use practice in the area — Tea farming with woodlots of Eucalyptus spp.
- Impact of exotic spp to Indigenous (Commercial) — Exotic spp. give them income because they sale fuelwood to the tea factories around.
- Impact of tree plantations (Eucalyptus spp) to the Aborigine forests — There is no impact of Eucalyptus spp to the Aborigine forests.
- Forest practices in Karumba — The upper zone which is mainly tea growing area has woodlots of Eucalyptus spp as the dominant tree spp. while the lower zone which is mainly coffee growing area has Grevillea robusta as the dominant tree spp.
- Growing of Eucalyptus spp. in water catchment areas eg springs is not recommended though some farmers have planted along the rivers (upstream area)
- As long as the tunnel will be underground there will be no impact of construction to the forests.
- There are several self help groups in the area
- Most of the schools/institutions have been engaged in tree growing.
- Most of the trees are consumed by the tea

factories around at fuelwood for tea curing
also for supply of timber for construction. The
demand is high.

— Those who have engaged in forestry as an
economic activity have really benefited in the
sale of fuelwood and timber. Most of the
tea growing areas have a relationship with forest
because most of them are situated near forests

— Forestry services in the area — Kenya Forest Service
have tried to reach the people for services
to engage in tree growing and management of
forests and woodlots despite several challenges.
These include — Inadequate forest personnel and
lack of means of transport.

— There is no major impact of water sources in rela-
tion to planting of Eucalyptus spp as long as
the tree spp. is ~~correct~~ appropriately sited.

— The cultural/Heritage sacred sites around Kangema
are in the Aberdare forest.

Name — John N. Ndagi

Contacts — 0721-900164

Organization — Kenya Forest Service

Designation — Sub-County Forest Officer

Locality — Kangema

Date — 6th August 2014

Signature — 

SUB-COUNTY FOREST OFFICER
KANGEMA

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT
ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1**

STAKEHOLDER CONSULTATION GUIDE

SUB-COUNTY / MEDICAL OFFICER OF HEALTH

Introduction

The Government of Kenya has received funds from the World Bank and Agence Française de Développement (AFD) for the Water and Sanitation Improvement Project (WaSSIP). An Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, Downstream Works, a Raw Water Pipeline, Raw Water Treatment Works situated 6km Downstream of Thika dam and Treated Water Pipeline to Kabete Reservoir. To achieve this AWSB which is to implement the project on behalf of GoK has contracted GIBB Africa to develop ESIA & RAP to mitigate on impact on property

The aim of this study is to collect information at household level and from stakeholders for the purposes of impact analysis and development of mitigation measures.

1. What are the top ten common illnesses within the Sub-county / District specifically the project area that is Kanyenyaini division?

KINTONA DIVISION:

- | | |
|----------------------|----------------------|
| 1. U.R.T.I | 6. Pneumonia. |
| 2. Skin diseases. | 7. Diarrhoea. |
| 3. Hypertension. | 8. Diabetes. |
| 4. Intestinal worms. | 9. Arthritis. |
| 5. Injuries | 10. Gastroenteritis. |

2. What is the doctor patient ratio in the ⁵⁷county / area?

2 doctors within the sub-county.

3. What are the HIV/AIDS prevalence rates in Muranga?

Muranga - 5.2%

4. What initiatives are in place to mitigate the spread of the above illnesses?

Through community based organization the following is done to mitigate the spread of HIV/AIDS.

1. Support orphan and vulnerable children.

2. H.I.V. counseling and testing.

3. Health Education to people living with HIV/AIDS.

4. Referral of infected people to Health facilities.

5. What is the status of HIV / AIDs in the Sub-county / District?

5.2%

6. Which is the most vulnerable group to HIV/AIDS infections?

The most vulnerable groups are

(15-24) years

(33-44) years.

7. What health programs does the department have to deal with

a. HIV/AIDS menace?

T.O.W.A. - Total War Against HIV/AIDS.

b. TB

T.B and Leprosy Programme.

c. Vaccination

Kenya Expanded Programme on Immunization.

8. What is the number of health facilities available in the locality? What are the categories and distribution? The following are the health facilities in Kigumo sub-county as per their categories.

| DIVISION | NO. OF FACILITIES | CATEGORY. |
|----------|-------------------|---------------------------|
| KIMOMA | 1 | Health Centre |
| | 7 | Dispensaries |
| | 3 | Faith Based Organisation. |
| KICUMU | 1 | sub-county Hospital. |
| | 1 | HI Centre |
| | 1 | Dispensary. |
| MUTHIHI | 1 | HI Centre |
| | 3 | Dispensary |
| | 1 | F.B.O. |

9. What are the services offered in the health facilities near the project area?

1. curative service which are offered in out patient department.
2. comprehensive care and support centre for HIV/AIDS PATS.
3. Laboratory services.
4. Immunization services.
5. Reproductive Health services.

10. Do you foresee any positive impacts from the proposed Northern Collector Tunnel development?

Yes or No, if yes what impacts do you see

i. During construction

Employment to the local community members.

ii. During operation

None.

11. Do you foresee any negative impacts from the proposed Northern Collector Tunnel development?

Yes or No, if yes what impacts do you see **Yes.**

i. During construction

- Accidents
- Displacement
- Noise pollution
- Air pollution (dust)
- Destruction of trees, fruit crops and cash crops.
- Sexual transmission infection.
- Drug and alcohol abuse
- Unwanted pregnancies
- Death.

ii. During operation

12. If your answer No. 11 is Yes, please suggest how the anticipated negative impacts can be mitigated.

i. During construction

Noise & Accidents - workers to be provided with protective devices.

→ Sensitize the community before the commencement of construction works.

Displacement - compensation.

Bad Air pollution (Dust) - wetting the ground.

Drug & alcohol abuse - Sensitize the community.

S.F.I. - Sensitize & supply of condoms.

School dropout - Health Education to the pupils.

ii. During operation

Unwanted pregnancies - Health Education to the community & adolescents.

Stakeholder Contacts:

| | | | |
|---------------------------------------|--|------------------------------|--|
| Name: | JOHN K. MBUGUA | | |
| Contacts: | Tel: N/A | Mobile: 0724080328 | e-mail: johnkamanmbugua@gmail.com |
| Organization Represented: | MINISTRY OF HEALTH | | |
| Designation: | SUB-COUNTY PUBLIC HEALTH OFFICER | | |
| Locality: | KIGUMO | | |
| Date: | 6/8/14 | | |
| Signature: |  | | |
| Official Stamp: (if available) |  | | |

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1

STAKEHOLDER CONSULTATION GUIDE

SUB-COUNTY / DISTRICT WATER OFFICER - KIGUMO

Introduction

The Government of Kenya has received funds from the World Bank and Agence Française de Développement (AFD) for the Water and Sanitation Improvement Project (WaSSIP). An Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, Downstream Works, a Raw Water Pipeline, Raw Water Treatment Works situated 6km Downstream of Thika dam and Treated Water Pipeline to Kabete Reservoir. To achieve this AWSB which is to implement the project on behalf of GoK has contracted GIBB Africa to develop ESIA & RAP to mitigate on impact on property

The aim of this study is to collect information at household level and from stakeholders for the purposes of impact analysis and development of mitigation measures.

1. What is the main water source for communities living in the project area?

- Piped water - Irithi - Lower sections - lower sections
- Rivers
- Springs
- Wells / shallow wells - lower sections of sub-county.

2. Who are the Water Users of Maragua, Irithi and Gikie Rivers?

- (1) Maragua - upper slopes
 - (2) Irithi
- } Closely with WARMS (Maragua)

3. Is / are there any Water Users Association for the above Rivers? What are their roles with regards to management of the River?

- Yes there are.
- (i) River Catchment Protection
 - (ii) Sanitization of community houses - Deposition
- } WARMS

4. In the event abstraction of water on Maragua River, Gikie River and Irati Rivers is to take place at $3\text{m}^3/\text{s}$, $1\text{m}^3/\text{s}$ and $2\text{m}^3/\text{s}$ respectively to the collector tunnel. What is the foreseen net impact of this to the

(a) Rivers

- Reduction of flow below abstraction point
hence affect other major abstractions
like Murang'a town and environs.

(b) Community living around an using the river waters

- (i) for the domestic users - little or no effect
(ii) for water project projects below the intake -
will experience reduced volumes more so
during the dry seasons.

5. What corrective measure should be adopted to solve or enhance the above?

Erect a dam up stream to
measure flow and volumes.

6. Do you foresee any positive impacts from the proposed bulk water tunnel development?
Yes or No, if yes what impacts do you see
i. During construction

YES

i. Supply to existing & new community water projects.

- ii. During operation

employment opportunities to locals

7. Do you foresee any negative impacts from the proposed bulk water tunnel development to the environment and water resources around the project area?
Yes or No, if yes what impacts do you see
i. During construction

- disruption of existing water systems (Minimum)
- disruption and possible destruction of ground water flow systems - lead to negative impact on water sources on the lower reaches of the sub-county.
- sound will affect human and livestock daily operations and production.
- direct effect on social-economic activities along the tunnel.

- ii. During operation

- ~~Positive~~ None.



B. If your answer No. 3 is Yes, please suggest how the anticipated negative impacts can be mitigated.

i. During construction

Use of Probe Machine, with little or no no
impact on rocks / affluents.
- Use Machine, with little or vibrative impact.

ii. During operation

Stakeholder Contacts:

| | | | |
|--------------------------------|---|---------|---------|
| Name: | DAVID - N. GICHONI - Duro | | |
| Contacts: | Tel: | Mobile: | e-mail: |
| Organization Represented: | Kigumo Sub-County Water office | | |
| Designation: | Sub-county water officer | | |
| Locality: | Kigumo Sub-County | | |
| Date: | 6/8/014 | | |
| Signature: |  | | |
| Official Stamp: (if available) | <p style="text-align: center;"> DISTRICT WATER OFFICER KIGUMO DISTRICT P.O. Box 281-10203, KIGUMO 6/8/014 Sign  </p> | | |

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT
ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE I**

STAKEHOLDER CONSULTATION GUIDE

INTERVIEW GUIDE

WATER RESOURCES MANAGEMENT AUTHORITY

Introduction

The Government of Kenya has received funds from the Agence Française de Développement (AFD) and additional financing from the World Bank for the WaSSIP. An Environmental and Social Impact Assessment (ESIA) (to include a cumulative impact assessment) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, Downstream Works, a Raw Water Pipeline, Kigoro Raw Water Treatment Works situated 6km Downstream of Thika dam and Treated Water Pipeline to Kabete Reservoir. To achieve this AWSB which is to implement the project on behalf of GoK has contracted GIBB Africa to develop ESIA & RAP to mitigate on impact on property

The aim of this study is to collect information at household level and from stakeholders for the purposes of impact analysis and development of mitigation measures.

We kindly request for your opinion in line with the issues noted below to facilitate the development of the ESIA Report.

1. What is the main water source for communities living in the project area?

Main water source is the rivers
of Maragua, Gikigie, Irati, Iche
Muguthi, Kenya and Thuchu, Gatundu
Kashuni, Gitumboka, For Chirika, Kayungu

2. Who are the Water Users of Maragua, Irati and Gikie Rivers?

= Farmers
- Institutions → Tea factories, schools
health centres and
- Market Centres
= Commercial abstractors (irrigators)

3. Is / are there any Water Users Association for the above Rivers? What are their roles with regards to management of the River?

Maragua WQUA, Upper Thika WQUA

6. Do you foresee any positive impacts from the proposed bulk water tunnel development by AWSB?

Yes or No, if yes what impacts do you see

i. During construction

- = Employment opportunities
- = Improvement of roads during construction.

ii. During operation

- Benefit of direct supply of water
- Improved hygiene and living standards.

7. Do you foresee any negative impacts from the proposed bulk water tunnel development by AWSB to the environment and water resources around the project area?

Yes or No, if yes what impacts do you see

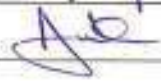
iii. During construction

- = Catchment degradation where the pipe pipeline passes through.
- = Situation and turbidity of water in the mentioned rivers.

iv. During operation

- Community will be charged water levies.
- The water levels will decline and there will be this might bring water conflict to the downstream users.

Stakeholder Contacts:

| | | | |
|--------------------------------|---|------------|---------------------|
| Name: | A. WANJIKU NIQU | | |
| Contacts: | Tel: | Mobile: | e-mail: |
| | | 0721810091 | wanjikugo7@jphw.com |
| Organization Represented: | WRMA | | |
| Designation: | SWO | | |
| Locality: | MURANGA | | |
| Date: | 7/8/2014 | | |
| Signature: |  | | |
| Official Stamp: (if available) | | | |

Faith w. mbathi - SWO
 mobile 0721810091
 email fwmbathi@gmail.com
 MURANGA
 12/8/2014
~~fwmbathi~~

SUB-REGIONAL MANAGER
 WATER RESOURCES MANAGEMENT
 AUTHORITY
 UPPER TANA

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT
ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE I**

STAKEHOLDER CONSULTATION GUIDE

SUB-COUNTY / DISTRICT GENDER AND SOCIAL DEVELOPMENT OFFICER

Introduction

The Government of Kenya has received funds from the World Bank and Agence Française de Développement (AFD) for the Water and Sanitation Improvement Project (WaSSIP). An Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, Downstream Works, a Raw Water Pipeline, Raw Water Treatment Works situated 6km Downstream of Thika dam and Treated Water Pipeline to Kabete Reservoir. To achieve this AWSB which is to implement the project on behalf of GoK has contracted GIBB Africa to develop ESIA & RAP to mitigate on impact on property

The aim of this study is to collect information at household level and from stakeholders for the purposes of impact analysis and development of mitigation measures.

1. What are the NGOs and Community Based Organizations (CBO's) within the project area?

NGOs - 0

CBO's -

2. Which groups are considered vulnerable in the community? (With emphasis on the community around the proposed tunneling project site)

1. Persons with disability.

2. People living with HIV/AIDS

3. Orphans.

3. What are the main social problems in the project area

1. Food insecurity due to overdependence on cash crop that is tea.
2. Poverty - Poverty varies from upper zones to lower zones in the district. The lower zone is poorer.
3. HIV/AIDS

4. What programs do you have in place to solve the above mentioned challenges

- i. Initiation of groups dealing with agricultural and livestock production to tackle food security
- ii. To tackle poverty, the office has promoted table banking to raise the living standards of the community.
- iii. Groups doing small scale businesses, Small Enterprise Groups.

5. What economic and social activities are the vulnerable members of the community involved in?

- i. Daring subsidies to this category of people when it comes to development initiatives.
- ii. Tea picking.

10. Casual labour at the nearby tea factory.

6. What support or welfare do you have in the project area

1. Bursaries to the orphans through the department of children.
 11. Cash transfer program to the elderly, Orphans and persons with disability.
 14. Provision of seeds and fertilizers for free by ministry of agriculture.
 10. Persons with disability are exempted from pay. for medical care by APDE. (nearby two clinics Kirundo & Mombasa)
7. What are the socio-cultural norms that guide property ownership specifically Land within the project area.

1. Land belongs to men, a trend which is currently changing to favor of women esp where husbands are dead.
11. Land is inherited along male ~~line~~ line. but women are now inherited.

8. Gender Issues

a) Resource ownership: Indicate sex (M/F)

| Resources | Who buys | Who owns | Who controls | Who uses |
|-------------------------------|----------|----------|--------------|----------|
| Land | M | M | M | F |
| Trees and Forest | M | M | M | F |
| Livestock | M | M | M | F/M. |
| Crops - Cash | M | M | M | M/F |
| Household property | F | F | F | F |
| Cars motorcycles and bicycles | M | M | M | M. |
| Livestock - Small chicken | F | F | F | F |
| Crops - Subsistence | M/F | M/F | F | F |

* Decision making at Household level is vested on male.

b) Gender roles: Who does the following? (Tick where applicable)

| Activity | Men | Women | Boy | Girls |
|-----------------------|-----|-------|-----|-------|
| Digging | ✓ | ✓ | ✓ | ✓ |
| Cooking | | ✓ | | ✓ |
| Food collection | | ✓ | | ✓ |
| Vegetable collection | | ✓ | | ✓ |
| Fetching water | | ✓ | | ✓ |
| Washing utensils | | ✓ | | ✓ |
| Collecting firewood | | ✓ | | ✓ |
| Looking after animals | ✓ | ✓ | | |
| Washing clothes | | ✓ | | ✓ |
| Total task | 2 | 9 | 1 | 8 |

(most animals are zero grazers)

9. Are you aware of any site of historical / Archeological importance to the community in the project area?

No information but advised to verify on site.

10. Are there NGO's and / or CBOs in the project area? If Yes, Please List them and their roles

TO BE PROVIDED

11. Do you foresee any negative impacts from the proposed development of the tunnel?

Yes or No, if yes what impacts do you see

i. During construction

1. Relocation of population and loss of land.

11. Impact on crops could lead to further food insecurity as food crops ^{are} grown at the river banks.

ii. During operation

None

12. If your answer No. 7 is Yes, please suggest how the anticipated negative impacts can be mitigated.

i. During construction

1 - Compensation should be paid for land and crop loss.


ii. During operation

None

13. What are your comments on this exercise?

1. The project should offer employment to the local community in jobs that they can do to improve ownership of the project.

Stakeholder Contacts:

| | | | |
|---------------------------------------|--|----------------|----------------|
| Name: | FIDELIS NGANCA . | | |
| Contacts: | Tel: | Mobile: | e-mail: |
| Organization Represented: | DISTRICT SOCIAL DEVELOPMENT OFFICE . | | |
| Designation: | SOCIAL DEVELOPMENT ASSI . | | |
| Locality: | KICUMU | | |
| Date: | 6/8/2014 | | |
| Signature: |  | | |
| Official Stamp: (if available) | <p style="text-align: center;">DISTRICT SOCIAL DEVELOPMENT OFFICE MURANG'A SOUTH DISTRICT</p> | | |

06/08/2014.

NOTES TO MEETING WITH SUB COUNTY FISHERIES OFFICER KIGUMO.

PRESENT: (FISH FARMING EXTN' OFFICER)
MR. JOHN NDURUNGU - SUB COUNTY FISHERIES OFFICER
MICHAEL KABARI W- ENVIRONMENTALIST.

COMMENTS:

- # Kigumo sub county has fish farmers that were originally E.S.P. farmers (Economic stimulus programme). There are few private farmers - individuals (locals).
- # The farmers use Earthen Ponds. They don't get water from rivers though they get from underground. There are proposed suggestion to have a Community Fish farming project close to the foot of Abadane's to breed Trout fish.
- # Challenges to fish farming:
 - ⊙ Feeds availability
 - ⊙ Fingerlings availability for other fish other than *Tilapia* to eg. Cat fish & Trout fish.
 - ⊙ Market - currently there's a company (Forthall Fish processors) that buy fish from farmers & also provide / sell feeds for fish farmers.
 - ⊙ Cost of liner ponds is a challenge to introduce the improved method of fishing.
- # There are currently 30 farmers with lined ponds including institutions such as:
 - ⊙ Karakwa Sec. school; 1 pond
 - ⊙ Njini's sec school; 1 pond
 - ⊙ Kangari Polytechnique; 1 pond
 - ⊙ St. Deborah Academy 1 pond } all of 300m².
- # The proposed project will increase markets of fish farmers' prod

- # Kigumo sub county has one Community driven fish farming group. A cluster group with each having own pond. The department encourages cluster so as to facilitate training, education & management of fishing pond. (Group Mwirutini self help group) in Kinyona Ward funded by N.M.K. (Njaa Marufuku Kenya) under the Min. of Agriculture. There are plans to make the second pond.
- # Species in Kigumo are ; Tilapia, Cat fish and ~~early~~ lately introduced Trout. Cat fish does well in warm °C.
 - ⊙ There are plans to trans/change the farming in Kinyona to Trout farming as it does well in cold regions such as at the base of Aberdare Forest.
- # Update : more fish farmers are going for cat fish due to the mass (return of cash - cost of farming). The department is introducing green houses to grow/breed cat fish to control cost - for maximum production and cost return.
- # During the introduction of the ESP. fish farmers were given ~~both~~ ^{mixed} sex fish for the Tilapia that causes small sized full grown fish. To date farmers are encouraged to breed mono-sex Tilapia and cat fish so as to attain the big sized fish for selling for maximum profit.
- # The fish farming is being taken up very well (in 3 years there are 97 fish farmers) and the growth is high. The department is working hand in hand with the farmers and with the help of the County Govt to upgrade the fish farming so as to ensure the ponds produce high yield in cat fish.
- # Currently we have 15 cluster groups of fish farmers ~~that~~ in Kigumo sub county.
- # All markets for fish are local. Fort hall is a large market in ~~Ken~~ Kigumo where he is at the level of packing. It's

challenge being the volumes to export (potential).

John Ndurungo (F.F.E.O)

P.N. 2011222305



6/8/14

TEL 0721 241938

Email Johnndurungo@Tchro.com.

06/08/2014.

NOTES TO MEETING WITH SUB-COUNTY FOREST OFFICER - KIGUMO.

PRESENT:

- ⊙ MR. PETER MWIRI - SUB COUNTY FOREST OFFICER - KIGUMO.
- ⊙ MICHAEL KABARI W. - ENVIRONMENTALIST (GIBB AFRICA)

COMMENTS:

- # Tree species in Gatare forest (part of the Aberdare forest).
 - (i) Podocarpus milanjianus (Kikuyu \Rightarrow Muthengera)
 - (ii) Syzygium guineense = (Kikuyu \Rightarrow Mukoe).
 - (iii) Croton spp. (i) Mutunda wa Nduma, Kikuyu + Mukinduri).
 - (iv) Prunus africana (Muiri, kik.)
 - (v) Indigenous bamboo (also called mountain bamboo \Rightarrow Miringi in Kikuyu, Arundinaria alpinae).
 - (vi) Macaranga kilimandscharica (Mukuhakula, Kikuyu)
 - ~~(vii) Nesogordonia spp. (Munoti - common name)~~
 - ~~(viii) Ficus spp. = Riverine spp.~~
 - (ix) Dombeya goetzei (Mukeu, Kikuyu)
 - ~~(x) Polyscias kikuyuensis~~
 - (xi) Nesogordonia parvifolia (Mlungu, common name).
- # The current land uses along the base of the forest is the Nyayo Tea zone that is the buffer zone to the human settlements.
- # The forest department encourages the planting of exotic / eucalyptus 6m. from other farmer and 60m. from the nearest water source.
- # On the farm land we have the Granellia (Mukima) spp. and few cases of Cyprus spp.
- # Exotic trees in the area grow very fast and are felled fast for timber and fuel wood for the (3) tea factories such as Gacharage Tea factory, Ikumbi Tea factory in Kigumo sub-county (and Makomboki Tea factory).

- # Within the Aberdares we have few exotic species such as Cyprus and Pines in their own zone separated from the rest of Indigenarous spp.
- # Aberdare forest is clustered with several forest such as:
 - # Gatane forest. — Gikigie, Irati & Cithanda ^{Gatabaki} Githika.
 - # Wanjerere forest. — Maragua River.
 - # Kimakia Forest. — Thika River, & Chania
- # Services such as advisory & education to plant and take care of projects. Work with Self help groups.
- ⊙ Market is not a problem as the demand is high. Most settlements have tree species along boundaries of farms.
- # It's important to involve the chiefs and administration so as to ensure all persons affected are involved.
 - It's important to construct during day time to minimize noise and vibrations of machinery & trucks.
- # Tree markets is local and mostly Nairobi. Demand is too high.
- # In Gatane forest ^{in Kigumo} there are Mau Mau Caves (Heritage sites) people go for recreation and history education.

NAME. Peter Muriuri

DESIGNATION Sub-County Forest Officer

OFFICE: Kigumo (Kenya Forest Service).

ID NO: 0615093.

TEL NO: 0721288200.

SIGNATURE: 

DATE AND STAMP:



06-08-2014.

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT
ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE I**

STAKEHOLDER CONSULTATION GUIDE

LAND OFFICER - Kigumo *MURANGA COUNTY.*

Introduction

The Government of Kenya has received funds from the World Bank and Agence Française de Développement (AFD) for the Water and Sanitation Improvement Project (WaSSIP). An Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, Downstream Works, a Raw Water Pipeline, Raw Water Treatment Works situated 6km Downstream of Thika dam and Treated Water Pipeline to Kabete Reservoir. To achieve this AWSB which is to implement the project on behalf of GoK has contracted GIBB Africa to develop ESIA & RAP to mitigate on impact on property

The aim of this study is to collect information at household level and from stakeholders for the purposes of impact analysis and development of mitigation measures.

1. What is the land tenure system in Kangema Sub-county / district and the project area?

✓ *Freehold - Private Land.*

This means that persons within this area own land in absolute.

2. What is the state of ownership of the land that is targeted for acquisition by the project currently?

✓ *All land parcels in the project area are registered. But to get adequate information on each parcel a land search is warranted.*

✓ *To initiate a land search, the office requires that they are provided with Land Registration No (LR) for each plot.*

3. Has land within the project area, that is Kanyenyaini, Kangari, Kinyona Divisions been adjudicated and / or title deeds issued?

YES. - They have been adjudicated and titles issued.

b. In the absence of Title Deeds or records of private ownership of land how does one get to know the **ACTUAL** land owner?

✓ Land search initiated at the Lands Office in Muranga.

✓ This requires provision of -

4. What is the price of land in Kangema ^{and Kigumo} Sub-county currently?

1. Sale is based on willing buyer - willing seller. The price averages is between 600,000 - 900,000 KES per Acre.

5. Give examples of projects or instances where land take for public purposes in the outlined project area in the recent past

1. Ndakacani dam - compulsory acquisitions which involved Nairobi City Council

Surveyor

6. What has been the past experience and lessons learnt in this district with regard to land take for public purposes? (challenges, good case practices and recommendations from the above or experience in other areas)

1. challenges will only be experienced at the intake works due to displacement of persons but not at the tunnel.

Surveyor

7. What are the existing grievance and conflict resolution mechanisms being practiced in the project area (both customary and formal)

1. Boundary disputes are handled by the District Land Registrars Office.

2. Other land disputes are usually taken to court.

8. What is the process of land transactions in the project area?

1. Check the status by buying a search.
2. Apply to the land control board for consent to transp
3. Preparation and signing of transfer forms.
4. Submission to District Land Registrar's Office for issuance of title.

9. In your opinion, what are the land use, settlement and migration patterns in the area? (

- i. Agricultural land.
 - ii. Human settlement is on top of hill.
- NB: Land is heavily fragmented. to land non-economically viable parcels of which some are registered but currently land allowed for registration is 1/4 acre and above.

10. Do you foresee any negative impacts from the proposed ~~gravity system~~ development?

- Yes or No, if yes what impacts do you see
- i. During construction

1. Low water levels that will be disastrous when abstracted.
- ii. Loss of land at the intake works and the outfall.

ii. During operation

1. Reduction in water levels which are already low in case of abstraction.

11. If your answer No.10 is Yes, please suggest how the anticipated negative impacts can be mitigated.

i. During construction

1. AWSB needs to create storages for water and distribute the same to the local community.



ii. During operation

1. As above.

12. What recommendations do you have for the study team and for AWSB in general?

1. Proposed construction of water storage so as to mitigate on low flows during dry season.

Stakeholder Contacts:

| | | | |
|--------------------------------|---|---------|------------------------------------|
| Name: | NANCY N. NJENGA | | |
| Contacts: | Tel: 0722 304 945 | Mobile: | e-mail: njenge nancy68@gmail.co |
| Organization Represented: | Ministry of Lands & Housing | | |
| Designation: | District Land Registrar | | |
| Locality: | Arathi House Murage | | |
| Date: | 7/8/14 | | |
| Signature: |  | | |
| Official Stamp: (if available) |  | | |

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT
ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1**

STAKEHOLDER CONSULTATION GUIDE

SUB COUNTY / DISTRICT AGRICULTURAL OFFICER

Introduction

The Government of Kenya has received funds from the World Bank and Agence Française de Développement (AFD) for the Water and Sanitation Improvement Project (WaSSIP). An Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) is required for the proposed Bulk Water Supply to Nairobi City – Northern Collector Tunnel, Downstream Works, a Raw Water Pipeline, Raw Water Treatment Works situated 6km Downstream of Thika dam and Treated Water Pipeline to Kabete Reservoir. To achieve this AWSB which is to implement the project on behalf of GoK has contracted GIBB Africa to develop ESIA & RAP to mitigate on impact on property

The aim of this study is to collect information at household level and from stakeholders for the purposes of impact analysis and development of mitigation measures.

1. What is the land tenure system in the project area?

Freehold

2. What is the land use pattern in the District and specifically in the project area due for land acquisition?

1. Agricultural production especially tea at top parts of land and steep areas.
 2. Fallow lands for grazing at the upper region of the tunnel location.
 3. Horticulture along the valley through irrigation
-
-

3. What are the agricultural practices of the community living in the project area?

1. Small scale farming

4. Which crops are grown by the community living in the project area?

| <u>Cash Crops</u> | <u>Food Crop</u> |
|-------------------|--|
| - Tea | - Maize |
| - Summer flowers | - Beans |
| - Snow peas | - Irish potato |
| | - Cabbage |
| | - Horticultural crops eg kale, pillipi tomatoes. |

5. What are the market rates according to the Agricultural Office for the above crops and trees found in the project area?

| <u>Crop</u> | <u>Market</u> | <u>Price / unit</u> |
|-------------|---------------|---------------------|
| 1. Tea | Export | |

SEE ATTACHED.

6. In the current state of agricultural production are there any noticeable health and safety issues? Explain

None

7. What are women's rights towards ownership to property and land in the Sub-county?

✓ Land is owned by men. It is men who control the use of land in the area.

✓ Women provide labour to land owners who are either husbands or locals.

8. Do you foresee any negative impacts from the proposed gravity system development?
Yes or No, if yes what impacts do you see

i. During construction

i. Impact on level of water after abstraction affecting communities on the lower part of the project

ii. Probable landslide during tunneling in steep terrain.

iii. Noise pollution.

iv. Cut to Spoil that may affect the community neighbouring the project.

ii. During operation

i. Impact on level of water thus affecting communities downstream or the reverse or Maragusa, Iraki and Gikigo.

ii. Restriction of access to the site where the tunnel has been constructed.

iii. Water conflict following going down of water table in the concerned rivers.

* iv. Impact on domestic water supply by Thika Ground

9. If your answer No. 8 is Yes, please suggest how the anticipated negative impacts can be mitigated.

i. During construction

i. Adequate sensitization of the community to be aware of both positive and negative impacts of the project prior to commencement.

ii. Proper disposal of waste material from construction process.


iii. Regulate wetting to reduce impact of dust pollution

ii. During operation

i. Regulation of Amount of water abstracted during dry season in order to ensure sustained supply to all users -

ii Rehabilitation of the catchment areas to facilitate boosting of water supply to the rivers

Stakeholder Contacts:

| | | | |
|---------------------------------------|---|----------------|---------------------|
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| Organization Represented: | Ministry of Agriculture Kigumo Sub County | | |
| Designation: | Sub county Agribusiness officer. | | |
| Locality: | KIGUMO | | |
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CLIENT: ATHI WATER SERVICES BOARD (AWSB)
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AND RESETTLEMENT ACTION PLAN (RAP) FOR NORTHERN COLLECTOR TUNNEL PHASE 1 AND THIKANGORONGO-KABETE PIPELINES
JOB NO: JK000987
TITLE: FINAL ESIA STUDY REPORT FOR THE PROPOSED NORTHERN COLLECTOR TUNNEL PHASE 1

| | Prepared by | Reviewed by | Approved by |
|---------------------------|--|---|--|
| ORIGINAL | NAME Aggrey Kwadha | NAME George Owuor | NAME Maurice Namiinda |
| DATE 31.10.2014 | SIGNATURE  | SIGNATURE  | SIGNATURE  |
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