



**NOL-TURESH LOITOKITOK  
WATER AND SANITATION  
COMPANY LIMITED**

**CONCEPT NOTE**

**REHABILITATION, IMPROVEMENT AND CONSTRUCTION  
NOLTURESH LOITOKITOK WATER SUPPLY AND SANITATION  
PROJECT**

**CONSULTANTS:  
HORICON ENGINEERING SOLUTIONS LTD**



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## EXECUTIVE SUMMARY

Nol-Turesh Water and Sanitation Company is mandated to supply Water to Loitokitok, Mashuuru, Nzaui, Mukaa, Athiriver/Mavoko, Machakos and Kajiado Sub-Counties which are primarily semi-arid. The source of water is from Nol-Turesh natural spring in Loitokitok, Kajiado County which has a yield 46,690m<sup>3</sup>/day. The water is relayed by gravity via a 22 Inch (550mm) diameter steel pipe and by pumping via a 6 Inch (150mm) diameter steel pipe.

The system, however, is grappling with outdated, worn out, dilapidated and vandalized facilities and fittings. Also, the system is under pressure due to the rapid population growth along the pipeline increasing the water demand and competing water demand such as irrigation. The system also lacks adequate quality control facilities to maintain and monitor water quality and control flows. In addition, there exist human-wildlife conflict for the limited water especially during dry seasons.

The current estimated water demand assuming 60 litres per person per day from the projected population data of 605,120 is 37,623m<sup>3</sup>/day while the ultimate water demand for a projected 2% annual population growth over 20 years is 71,598m<sup>3</sup>/day from an estimated population of 1,255,737. However, several other sources have been earmarked which can be investigated to augment the water supply.

Proposed improvements include additional distribution pipelines which would enhance community ownership of the project in line with Sustainable Development Growth Number 6. Ensure availability and Sustainable management of water and Sanitation for all. Construction of Water Pans which may serve to minimize human-wildlife conflict as well increase capacity of water for irrigation subsequently relieving water downstream. Rehabilitation of the existing pipeline to increase efficiency and reliability to be able to serve among others the upcoming Konza Technopolis which is key driver of Kenya's national development plan Vision 2030 and ultimately promoting the Big Four Agenda.

The Scope of Services required to achieve this objective include exploring other springs and boreholes along the pipeline for additional capacity of water. Design and Construct New Pipelines to adjoining communities and townships like Makindu. Rehabilitate, improve, add, replace and repair existing pipeline, fittings, facilities, equipment, access roads and reservoirs.



## BACKGROUND

Nolturesh Loitokitok Water and Sanitation Company Ltd (NOLWASCO) abstract its water from Nolturesh springs at the foot of Mt. Kilimanjaro in Loitokitok. According to Water Resources Authority (W.R.A), the springs yield 46,690m<sup>3</sup>/day of which 21,585m<sup>3</sup>/day is abstracted to Nolturesh pipeline and 985m<sup>3</sup>/day to Loitokitok town and its Environs.

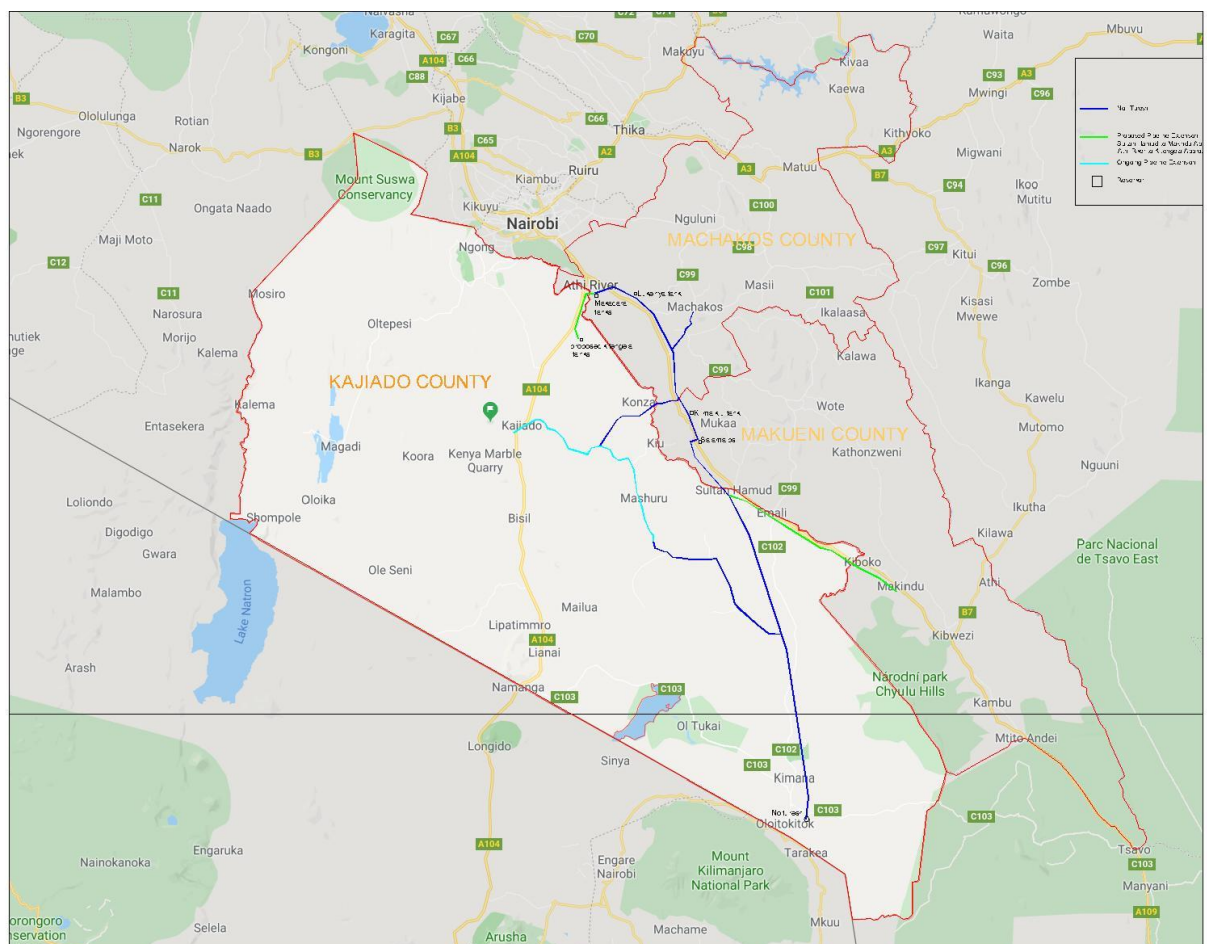


Figure 1-1: Location of Nolturesh source



The water is sourced from a natural spring at Nol-Turesh located at UTM 37 M 340613E 9675612S at an altitude of 1525 m above sea level. This is in Kajiado County, Kajiado South Sub-County approximately 2km off Oloitokitok – Laset, at the intake works, the water is channeled to a chlorine dosing chamber and then split into two main pipelines and an overflow channel back to Nol-Turesh River. An on-duty officer monitors and regulates the flow between the two main pipelines as well as the overflow to the Nol-Turesh River at any particular time. Quality Control is also monitored by Testing Samples and adjusting the chlorination dosage with respect to changes in the water quality.

NOLWASCO company supplies water from Nol-Turesh springs in Loitokitok in bulk to Machakos, Kajiado and Makueni counties then the distribution is done by Olkejuado Water and Sewerage Co. Ltd, Machakos Water and Sewerage Co. Ltd and Mavoko Water and sewerage Co. Ltd.



**Figure 1-2: Project layout**

## **Climate**

The supply area is primarily semi-arid. The average annual temperature in the is 18.9°C and has a bi-modal rainfall pattern with the short rains fall between October and December while the long rains fall between March and May.

## **Objective of the Project**

### ***Overall Objective***

The proposed project will increase the water supply in Loitokitok, Mashuuru, Nzau, Mukaa, Athiriver/Mavoko, Machakos and Kajiado Sub-Counties by the rehabilitation of the existing dilapidated pipelines, augmentation of existing pipelines and laying of new pipelines.

### ***Specific Objective***

The project intends to:

- Rehabilitate the existing DN 550mm Steel pipeline
- Repair/Replace and upgrade the fittings along the pipeline
- Explore and tap potential new spring sources along the pipeline
- Introduce new pipeline to supply water to adjacent communities & townships
- Improve overall sufficiency of the system by improving operation and monitoring



## PROBLEM STATEMENT

### Current Situation

#### Pipeline

There are two main pipelines from the intake works as follows;

*i. 200mm DN PN40 Steel Pumping Pipeline*

The treated water is directed through a 200mm DN PN40 Steel Pipeline to a Reservoir within the Intake Works Station where the water is pumped through 100mm DN PN40 Steel Pipeline to a 500 m<sup>3</sup> High Water Reservoir which then supplies water to Oloitokitok Township and its Environs.

*ii. 550mm DN PN40 Steel Gravity Pipeline*

This is the mainline that relays the bulk of the water from the intake works and is designed as follows:

**Table 1: Nol-Turesh Gravity Main Pipeline Details**

No.	Pipeline	Pipe Length (Km)	Pipe Diameter(mm)	Flow in (l/s)
1.	Nol-Turesh – Sultan-Hamud	108.30	550	165
2.	Sultan-Hamud – P.D.1(Branch to Kajiado)	35.80	550	143
3.	P.D.1 - PD2 (Branch to Machakos)	10.95	400	110
4.	P.D.1 – Kajiado	42.95	250	26
5.	P.D.2 – Athi River	33.95	250	40
6.	P.D.2 – Machakos	15.50	300	68
	<b>TOTAL</b>	<b>247.45</b>		

Other facilities along the Pipeline include 2 Pump Stations (i.e Salama and kajiado) and

#### Water Reservoirs

- 13.6 m<sup>3</sup> at Nzai,
- 3000 m<sup>3</sup> Bulk Reservoir at Kima Kiu
- 6000 m<sup>3</sup> Reservoir at Machakos
- 3500 m<sup>3</sup> Reservoir at Lukenya
- 1600 m<sup>3</sup> Reservoir at Kajiado

## Challenges

Currently, the pipeline system is not optimum as summarised below:

### **1. Increased Water Demand due to Rapid Population growth**

The project was designed and implemented in the year 1990. The project has exceeded its design life thus the increase in water demand.

### **2. Competing Water Demand such as Irrigation**

The region was previously domiciled by nomadic community whose main source of livelihood was herding and grazing of livestock. In recent time, the community has started partaking in crop farming and as a result using water resources for irrigation which has also increased water demand.

### **3. Vandalised and/or heavily dilapidated valve chambers**

Due to increased water demand some of the chambers have been vandalised in search of the precious commodity during the dry seasons. Some chambers along the main pipeline along Mombasa Highway have been knocked down by Motorist. Encroachment along the road reserve has also resulted in demolition of the chambers.

### **4. Leaking, outdated and worn out pumps and fittings increasing non-revenue water**

Most of the fittings installed 3 decades ago are worn out due to natural wear and tear over the years that they have been functional. Most of the fittings are also outdated and require to be replaced with more efficient and reliable modern fittings.

### **5. Frequent bust of the main pipe**

Due to internal corrosion of the Pipeline attributed to the vandalised cathodic protection system and overall design life there has been numerous pipe burst.

### **6. Illegal connection from the main pipeline**

Despite continuous monitoring of the pipeline, some unscrupulous individuals have illegally tapped water from the mainline for their own use.

### **7. Borehole abstraction up stream**

There have been several boreholes sunk up stream of the spring eye which has resulted in reduced the yield.



## **8. Lack of Flow Measuring Equipment for Monitoring and Control**

The outdated system does not have any flow measuring apparatus thus making it difficult for monitoring and control the water supply especially on non-revenue water.

Lack of adequate Quality Control facilities for Continuous Water Quality Monitoring

There are no water quality control measures for the system at the water source. Water Samples for quality control are taken to Government Laboratories in Nairobi or elsewhere in the region.

## **9. Dilapidated Pumping and Dosing Chamber Houses**

The facilities houses at the intake works and in particular the Pump House and Dosing Chamber House are in a bad state. Having been built over 30 years ago, they are in need of rehabilitation of the intake works.

## **10. Human Wildlife Conflict on Scarce Water Resources**

The pipeline passes through the corridor of Tsavo West & Amboseli where a number of wild animals cross. During very dry season the wildlife is attracted to the pipeline especially when there is a leakage or burst. This may attract wildlife invading adjacent farm lands.



## Population, Water Demand And Water Supply

### Population Projection

This chapter gives an estimate of the current population in the project areas and presents an assessment of the population projections and water demand. The year 2009 population figures for the project area have been obtained from the office of the Kenya National Bureau of Statistics (KNBS).

Taking the world bank growth rate of 2% the projected human population from 2019 is as follows:

**Table 2: Population Projection**

Population- Projection			
Census	Initial	Future	Ultimate
2019	2022	2032	2042
688,425	750,995	892,840	1,290,517

### Water demand projections

The concept takes design period as 20 years, as recommended by the Practice Manual for Water Supply Services in Kenya (2005). The following years have therefore been adopted;

Current year	-	2019
Initial Year	-	2022 (when it is estimated that construction will be complete)
Future Year	-	2032
Ultimate Year	-	2042

With World Bank per capita demand of 60 litres per person per day, the projected water demand is as follows:

Water Demand (m <sup>3</sup> /day)			
Current	Initial	Future	Ultimate
2019	2022	2032	2042
41,306	45,060	53,570	77,431

### Water Supply

Taking into consideration the projected population and water demand by ultimate year of 2042, the Nol Turesh eye yield of 46,690m<sup>3</sup>/day is not enough to meet 77,431 m<sup>3</sup>/day, therefore investigation of other sources and protection is required.

The sources available for investigation are as follows

	<b>WATER SOURCES</b>	<b>Estimated yield m<sup>3</sup>/day</b>	<b>Description</b>
	<b>Springs and bore holes</b>		
1	Nol turesh	46,690.00	According to Water Resources Authority ( <b>W.R.A</b> ), the springs yield <b>46,690m<sup>3</sup>/day</b> of which <b>21,585m<sup>3</sup>/day</b> is abstracted to Nolturesh pipeline and <b>985m<sup>3</sup>/day</b> to Loitokitok town and its Environs.
2	Enchorro Spring	Not measured	High yield so the spring need to be protected by construction of spring box cover.
3	Rombo Catholic Church Spring	Not measured	Tapped by the Catholic Church and is distributed to the surrounding locals as clean water for Drinking. Fencing need to be improved
4	Enduet Spring	Not measured	Low Water and it's in danger of being covered by sediments as a result of flooding. The Surrounding need to be fully Protected
5	Kisioki Spring	Not measured	The County Government of Kajiado had initially done some protection but it has been vandalised and Gabions destroyed by the Last Rains Floods.
6	EnkejuEmuny 3	Not measured	Locals have built some protection for the eye. The surrounding needs protection and the sanitary conditions can be improved
7	Enkeju Emuny2	Not measured	Low water yields pooled and pumped to nearby farms. The land surrounding the spring needs to be protected to ensure sustainable yield
8	Enkeju Emuny1	Not measured	Locals have built some protection for the eye. The surrounding needs protection and the sanitary conditions can be improved
9	Ololmatasia Spring 2	Not measured	Storage and distribution of the water to Olkaria residents possible from this site. The land around the eyes also needs protection
10	Ololmatasia Spring 1	Not measured	Storage and distribution of the water to Olkaria residents possible from this site. The land around the eyes also need protection
11	Illasit AIC Spring	Not measured	Small amount of water. Could be stored, treated, and accessed from the tanks while in sanitary conditions
12	Illasit 2	Not measured	Low water yields pooled and pumped to nearby farms. The land surrounding the spring needs to be protected to ensure sustainable yield.
13	Andrea Spring	Not measured	Water smells and is dirty due to farming and fish pond at the site
14	Gabriel 1	Not measured	Fair water yield that needs the land surrounding the spring and the eye to be protected to ensure sustainable yield and sanitary supply for the local population
15	Gabriel 3	Not measured	Built by AMREF. Currently under exclusive use by farm owner
16	Gabriel 2	Not measured	A trickle. The eye is disappearing
17	Gabriel 4	Not measured	Low water yields pooled and pumped to nearby farms. The land surrounding the spring needs to be protected to ensure sustainable yield.
18	Gabriel 5	Not measured	Has a good yield of water but unprotected and surrounded by farmland
19	Mwalimu's Spring	Not measured	A trickle

	<b>WATER SOURCES</b>	<b>Estimated yield m<sup>3</sup>/day</b>	<b>Description</b>
	<b>Springs and bore holes</b>		
20	Karima Springs 2	Not measured	The vegetation and land around the springs are unprotected. A steep and dangerous cliff is present here. The source also has a good yield of water that could be tapped and pumped to supply households. Reduce access by people and livestock at the eye by supplying water outside of source.
21	Karima Springs 1	Not measured	The vegetation and land around the springs are unprotected. A steep and dangerous cliff is present here. The source also has a good yield of water that could be tapped and pumped to supply households. Reduce access by people and livestock at the eye by supplying water outside of source.
22	Empiron Springs	Not measured	The area around the spring is fenced and the water from the spring tapped for irrigation. The eyes are not protected. The springs have good yield to supply water that could be tapped to supplement piped water to households in Kimana
23	Tikondo Springs	Not measured	The area around the spring is fenced and the water from the spring tapped for irrigation. The eyes are not protected. The springs have good yield to supply water that could be tapped to supplement piped water to households in Kimana
24	Buffalo Springs	Not measured	One eye is protected but not the area around it. If the vegetation is lost completely, it could damage water availability. Reduce access by people and livestock at the eye by supplying water outside of source.
25	Kawele Spring	Not measured	The eye is protected but not the area around it. If the vegetation is lost completely, it could damage water availability
26	Kimana Secondary Spring	Not measured	The eye is protected but not the area around it. If the vegetation is lost completely, it could damage water availability
27	Lesumbuka Spring	Not measured	Regulated tapping at the source could allow for pumping and distribution of clean water to residents of Kimana, Namelok, Isinet, and its environs
28	Saiko Springs	Not measured	Regulated tapping at the source could allow for pumping and distribution of clean water to residents of Kimana, Namelok, Isinet, and its environs
29	EsoitNaudo	Not measured	One of the sources of Kimana river. The source here appears to be almost completely drying up. The water is putrid and vegetation almost completely gone
30	Enkonguoo Isinet	Not measured	Regulated tapping at the source could allow for pumping and distribution of clean water to residents of Isinet and its environs
31	Engumi Spring	Not measured	Regulated tapping at the source could allow for pumping and distribution of clean water to residents of Namelok and its environs
32	Olmakau Spring	Not measured	Reduce access to the protected area as water production appears to be lowering at the current level of access by people at the eye.
33	Mero 1 and 2	Not measured	high yield so the spring need to be protected
34	6 bore hole	Not measured	2bore hole are already drilled but not equipped other to be drilled 0.8km apart, since they are fully exploited aquifers



## PROPOSED INTERVENTION

### 1. Project Ownership

In order to achieve ownership and identification of the project, the total generated domestic water will be shared among the three counties as follows:

Kajiado county and adjoining urban centres 44% supply

Location	Population category	Water Demand (m3/day)			
		Current	Initial	Future	Ultimate
		2019	2022	2032	2042
<b>Loitokitok Sub county</b>					
	Oloolopon	535	694	848	848
	Nkama	610	791	966	966
	Enkariak Rongena	470	610	745	745
	Entonet	232	301	368	368
	Olorika	341	442	539	539
	Elangata Enkima	529	686	838	838
	Inkisanjani	395	513	626	626
	Enkusero	187	242	295	295
	Itilal	203	263	321	321
	Oyarata	166	215	263	263
	Kimana	1,347	1,747	2,134	2,134
	Isinet	166	215	262	262
	Nkoroshoni	361	468	571	571
	Lemongo	252	327	399	399
	Oltiasika	525	681	832	832
	Ilchalai	450	584	713	713
	Olng'osua	137	178	217	217
	Imbirikani	136	176	216	216
	Chyulu	178	231	282	282
	Oldonyo Wuas	570	739	903	903
<b>Mashuuru Sub county</b>					
	Merueshi	336	356	435	532
	Masimba	170	180	220	269
	Kiboko	177	188	230	281
	Isara	142	151	184	225
	Mashuuru town & its Environs	390	414	506	618
	Imbuko	130	138	169	206
	Poka	369	392	479	585
	Nkama	354	376	459	561
<b>Nzau Sub county</b>					
	Emali	453	481	588	718
	Mulala	140	149	182	222
	Kwakakulu	120	127	155	190
<b>Mukaa Sub county</b>					
	Sultan Hamud	249	264	323	394
	Kaskeu	176	187	229	279
	Muani/Kavuthu	221	235	287	350



Location	Population category	Water Demand (m3/day)			
		Current	Initial	Future	Ultimate
		2019	2022	2032	2042
	Salama/kiima-Kiu	298	317	387	472
	Kavuko	63	67	81	99
	Malili	310	330	402	492
	Konza	48	51	62	76
<b>Kajiado Central</b>					
	Township	1,072	1,139	1,391	1,698
	Hospital	145	154	188	229
	Majengo	681	724	884	1,079
	Market	270	287	350	427
	Mashuuru	3,682	3,910	4,776	5,833
	Emotoroki	149	159	194	237
<b>Kajiado North</b>					
	Kitengela ward	2,582	2,742	3,349	4,090
	Iidamat ward	1,317	1,399	1,709	2,087
<b>Total</b>		<b>21,836</b>	<b>23,186</b>	<b>28,320</b>	<b>34,590</b>

Machakos county 33% supply

Location	Population category	Water Demand (m3/day)			
		Current	Initial	Future	Ultimate
		2019	2022	2032	2042
<b>Machakos County</b>					
	Machakos town	10,537	11,188	13,665	16,691
	Athi River township	3,987	4,233	5,171	6,315
	Konza Technopolis		1,200	-	12,000
<b>Totals</b>		<b>14,523</b>	<b>16,621</b>	<b>18,836</b>	<b>35,006</b>

Makueni county 23% supply

Location	Population category			Water Demand (m3/day)			
				Current	Initial	Future	Ultimate
				2019	2022	2032	2042
<b>Makueni County</b>							
	Makindu			4,218	4,479	5,471	6,682
	Kiboko			649	689	841	1,027
	Masimba			80	85	103	126
<b>Totals</b>				<b>4,946</b>	<b>5,252</b>	<b>6,415</b>	<b>7,835</b>



## **2. Additional Water Points**

There is need to do water supply points or create water pans along the river for domestic and wildlife consumption, from the adjoining ranches and game reserves where there is animal movement for pasture and mostly water. Creation of several water pans along the river to increase the storage for irrigation would also bring back the aquatic life along the river and tap flood water for storage.

## **3. Environment Protection**

The objective is to conserve the natural resources and existing natural environment by repairing and reversing the degradation trends, by applying the following:

- Preventing and or regulating Borehole drilling, pit latrines and quarrying activities upstream of the springs.
- Controlling and regulating farming along the river banks.
- Encouraging the planting of indigenous trees.
- Developing a wastewater collection infrastructure
- Protection of all spring eyes
- Collaboration with other stakeholders

## **PROPOSED SCOPE OF WORKS AND SERVICES**

The Scope of Engineering Procurement and Construction Services for Rehabilitation Improvements of Nol-Turesh and Loitokitok Water Supply and Sanitation is as follows: -

1. The design and improvement of other water sources to mitigate the projected demand, check on other spring eyes and their yields, add bore holes with specified yields, check their water quality and propose improvements for construction to the main supply lines.
2. Design and construct a parallel line along the main line to serve the adjoining communities, group ranches water points and other facilities to prevent vandalism of the main pipeline.
3. Proposal to increase bulk supply areas from Nzai reservoir at Sultan Hamud to Makindu approximately 65km, Athi river to Kitengela approximately 5km, Konza Technopolis and Mashuuru to Kajiado by designing and constructing of additional pipelines, storage facilities and reticulation are required.

4. Rehabilitate, improve, protect and construct the main pipelines, pipe route/access road, additional storage reservoirs, vandalized or worn-out fittings and chambers, dilapidated pumps and houses, dosing chambers and staff quarters/ camp.
5. Design, construct, desilt new and existing water pans along the pipeline road and the rivers to reduce human - wildlife conflict and also act as additional source of irrigation water for small scale farmers.
6. Audit and decommissioning all illegally sunk boreholes upstream of the source spring eye or reticulate and regulate.
7. Design and construct wastewater infrastructure in supply areas where there is none - existent.
8. Design, construct and automate all operations.
9. Carry out engineering survey of the proposed project.
10. Prepare preliminary designs for each of the proposed project.
11. Prepare Environmental and Social Impact Assessment project reports (and study where necessary) and submit to the National Environmental Management Authority (NEMA) and obtain licenses.
12. Prepare Confidential Cost Estimates for implementing of the proposed projects.
13. Prepare a funding model for the projects.



## BUDGET PROPOSAL

Rehabilitation Improvement and Construction of Nolturesh Loitokitok Water Supply and Sanitation Project		
Summary Bill of Quantities		
Bill No	DESCRIPTION	AMOUNT (USD)
1	General	1,874,441.26
2	Reticulation of adjoining communities, group ranches water points, water kiosks and domestic connections, protection of springs, construction of intake facilities and reticulation pipelines.	5,792,873.33
3	Bulk water supply from SultanHamud to Makindu, Athi river to Kitengela, Konza Technopolis and Mashuru to Kajiado	10,823,635.80
4	Rehabilitation of Main pipeline, Access road and Additional Storage facilities	28,211,057.65
5	Desilting existing water pans and construction of new water pans for wild life	2,110,196.08
6	Decommissioning and Commissioning boreholes	1,689,808.82
7	Waste water and treatment plants	6,999,110.97
8	Environmental Mitigation measures	241,214.31
<b>I</b>	Sub - Total 1 (Bill No 1 to Bill No 25)	57,742,338
<b>II</b>	Add 7.5% of sub-total 1 of Bills as Provisional sum for contingencies to be expended in whole or in part or deleted as directed by the Engineer.	4,330,675
<b>III</b>	Add the sum of 5% of sub-total 1 and subtotal 2 of bills as consultancy services .	3,103,651
<b>IV</b>	Sub - Total 2 (I+II+III)	65,176,664
<b>V</b>	Add 16% of Sub-Total 2 for Value Added Tax	10,428,266.28
<b>VI</b>	<b>Grand Total carried forward to Form of Bid (IV+V)</b>	<b>75,604,930.55</b>



## SUMMARY

Due to the rapidly expansion of settlements with a moderately high rate of population growth, water supply and sanitation is imminent, this will greatly contribute to enhancement of public health and environmental protection. The project will also be a key pillar towards achievement of the millennium development goals and vision 2030. Its geographical location and close proximity to the proposed Konza Technopolis and other development as the main water source also serve in promoting the Big Four Agenda.

Sustainability of the water supply systems is indicated by customer satisfaction, financial benefit, and possibility of system improvement is affected significantly by technology selection, institutional ability, and community participation. It is recommended that strategy of water supply development must consider technical and non-technical aspects.

