THE PROPOSED

ELDORET ICDC INDUSTRIAL PARK

BASELINE AIR QUALITY & NOISE AND VIBRATION ASSESSMENT REPORT

APRIL 6TH 2016

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i) EXECUTIVE SUMMARY

An Expert from Ecoserv Laboratory (NEMA Approved Lab) carried out air quality and noise survey at the Proposed Eldoret ICDC Industrial Park, on 6th April 2016. The Air quality and Noise survey is part of Strategic Environmental Assessment (SEA) required by NEMA to establish the Baseline Air Quality and Noise and vibrations Levels at the proposed project site. The baseline data obtained shall be used for comparison and control when mitigating the noise and air pollution from the proposed Industrial Park development.

Currently, the air emission at the proposed project sites is mainly dust and vegetation debris blown by wind.

Summary of the findings at the proposed sites

The air quality (Dust Concentration) emission and the noise levels at the site are low and within the accepted limit.

During development phase, the air quality shall be compromised and noise levels shall be increased above the current levels. To avoid negative impacts from development process to the existing environment, various mitigations provided in this report shall need to be applied to reduce negative impacts. The Environmental Management Plan (EMP) to be put into place shall include measures and targets for the control of dust and noise during development phase. This approach will be necessary to minimize dust and noise impacts to the nearest occupied buildings and to ensure that the pollution from development activities shall not affect operations in the neighbourhood or affect wellbeing of the residents within the vicinity of the proposed project road.

The dust that will be generated during operation phase is not expected to impact negatively to the environment beyond 200m from proposed development since the open sites will be tarmacked and surrounding areas well landscaped.

It is predicted that road traffic pollution at the proposed site shall be elevated during development and decrease after development.

The details of the baseline noise and air quality measurement results are presented in **Table 1, 2** and **8, 9** in this report.

Ecoserv Laboratory **Tehilla Company Limited**

NEMA Registered Laboratory **NEMA Registered Firm of Experts**

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1.0 AIR QUALITY ASSESSMENT

1.1 Introduction

The air quality assessment was carried out at the proposed site by an Expert from Ecoserv Laboratory on 6th April 2016 from 9.30 am to 1.05 pm. with the aim of establishing baseline air quality and noise levels at the proposed development site to obtain data that can be used to form basis for planning the control measures to eliminate or minimize human and environment exposure from noise air negative impact from the proposed development activities.

The air concentration levels obtained after analysis were compared with the EMCA Air Quality Regulations Legal Notice No.34 and World Health Organization (WHO) standards Guidelines, while the Noise levels were compared with Kenya Regulations (NEMA (Noise and Excessive Vibration Pollution Control)).

1.2 The aim of the survey

The aim of the assessment was to establish the baseline air quality in terms of concentration of suspended particulate matter (Dust) and ambient noise levels before development at the proposed site and to get data that can be used to form basis for planning the control measures to eliminate or minimize negative impacts to human and environment during development phase.

2.0 PARTICULATE MATTER (Dust)

The suspended particulate matters are tiny dust particles that may be inhaled into lungs causing lung damage. These particles come from shredded or crushed materials, dust generally blown by wind, smoke, or from dust from construction activities. The particles can also include soot, dirt, or liquid droplets emitted from chimneystacks and other sources.

The dust particles from construction activities contain particles of a wide range of sizes. The behaviour, deposition and fate of any particular particle after entry into the human respiratory system and the body response depend on the particle size. In this case, the particle size negatively affect human is the total inhalable dust (dust less than10μ diameter).

2.1 The Dust Health Effects

The main particulate matter at the proposed land project is soil dust blown by wind and motor vehicles accessing the sites. The majority of the dust particles do not remain in air but fall as dust on the floor, tree leaves and on top of buildings. The active component of the dust is that dust fraction that remains in air and is capable of being breathed into the lungs.

However, the body is capable of filtering out large particles while the smaller particles are inhaled to cause lung damage, breathing problems, and may also trigger asthmatic attach including diseases of the respiratory systems such as dysponea, emphysema and chronic bronchitis. The occurrence of these conditions in human depends on dust concentration and duration of exposure to the person.

To control exposure to workers during development phase, protective breathing masks must be used at the construction site and to control excess dust exposure to environment, dust suppression at the proposed sites must be applied which is mainly spraying water at the open sites under construction during dry season.

2.2 Definition of Total Inhalable Dust

The total inhalable dust is '*The mass concentration of ambient airborne particles of aerodynamic diameter **d** inspired through the nose and mouth, as a fraction of the ambient airborne mass concentration of those particles before the air is affected by the presence of the exposed individual and inspiration, under the prevailing conditions of air movement'.* That is*:* the fraction of airborne particulate matter that enters the nose and mouth during breathing, and is therefore available for deposition anywhere in the respiratory tract. This fraction is termed 'inspirable' by the

International Standards Organization (ISO) and by the American Conference of Governmental Industrial Hygienists (ACGIH).

2.3 Dust Assessment method

Static dust samples (total dust) of size less than 10µm aerodynamic diameters were taken on Millipore cellulose .08µm membrane filter by placing pre-weighed filters at the site of interest for ten to twenty minutes.

A close supervision on the sampling instrument was taken to make sure that the sampler was operating as expected.

2.3.1 Dust Analysis

The concentration of suspended particulate matter (dust) is determined by a gravimetric method. The sampling time and frequency corresponded to the character of the sampling site. The amount of dust captured on the filter (mg) is determined gravimetrically as a difference between the weight of the filter before exposure to dust and the weight of the filter and dust. The results of the measurements are tabulated in **Table 1.**

2.4 Observations during survey

During the survey, the following observations were made:

- The proposed site was wet as it had rained heavily previous night and there was very little free floating dust particles and no noisy activities. However, there were domestic animals within the proposed lands.

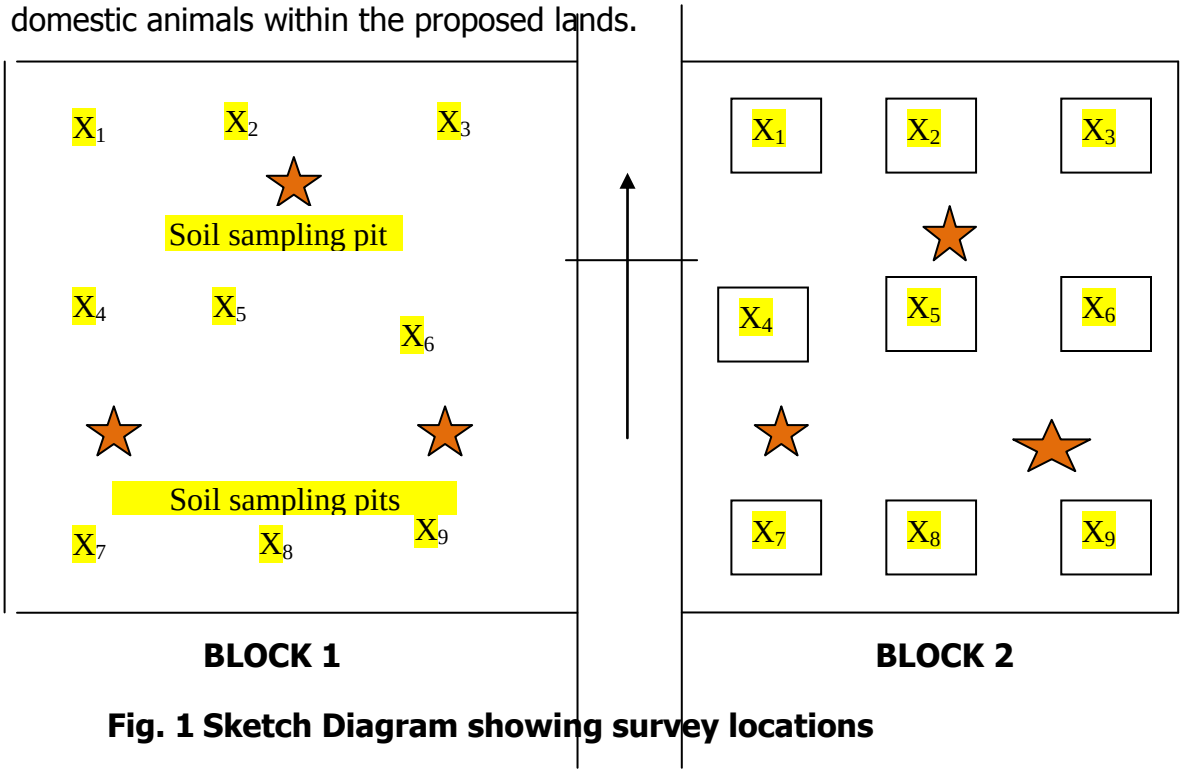

Fig. 1 Sketch Diagram showing survey locations

TABLE 1 : Block 1- Air Quality Levels (mg/m^3) (Dust concentration)

LOCATION/SITE & (Coordinates)		Measured concentration levels (mg/m^3)	TLV mg/m^3	REMARKS
1	Position ($X_{1)}$ North East location	0.095	**0.14**	Within the limit
2	Position (X_2) North centre	0.024	**0.14**	Within the limit
3	Position (X_3) North West location	0.035	**0.14**	Within the limit
4	Position (X_4) Middle West location	0.023	**0.14**	Within the limit
5	Position (X_5) Middle Middle	0.034	**0.14**	Within the limit
6	Position (X_6) South East location	0.054	**0.14**	Within the limit
7	Position (X_7) South Middle side	0.034	**0.14**	Within the limit
8	Position (X_8) South centre fence	0.025	**0.14**	Within the limit
9	Position (X_9) South west location	0.045	**0.14**	Within the limit

TABLE 2 : Block 2- Air Quality Levels (mg/m^3) (Dust concentration)

LOCATION/SITE & (Coordinates)		Measured concentration levels (mg/m^3)	TLV mg/m^3	REMARKS
1	Position ($X_{1)}$ North East location	0.095	**0.14**	Within the limit
2	Position (X_2) North centre	0.024	**0.14**	Within the limit
3	Position (X_3) North West location	0.035	**0.14**	Within the limit
4	Position (X_4) Middle West location	0.023	**0.14**	Within the limit
5	Position (X_5) Middle Middle	0.034	**0.14**	Within the limit
6	Position (X_6) South East location	0.054	**0.14**	Within the limit
7	Position (X_7) South Middle side	0.034	**0.14**	Within the limit
8	Position (X_8) South centre fence	0.025	**0.14**	Within the limit
9	Position (X_9) South west location	0.045	**0.14**	Within the limit

2.3.3 Discussion of the results

From the measurement results, the dust level at all sections surveyed is within the recommended threshold limit values (TLV).

3.0 GREENHOUSE GASES

The field measurements at the proposed land development were undertaken to determine the concentration of greenhouse gases emission namely: Carbon monoxide (CO), Carbon Dioxide (CO_2), Sulphur Dioxide, (SO_2) and Volatile Organic Compounds (VOC)

3.1 Air Quality Guidelines

The results of the measurements obtained at the proposed Project were benchmarked against EMCA Air Quality Regulation Legal Notiice No. 34.

The objective of these guidelines is to protect human health and the environment from air pollution.

3.2 Greenhouse Gases Background Information

i) Sulphur dioxide (SO_2)

SO_2 is a colourless, pungent, irritating water-soluble and reactive gas. The gas is generated through the combustion of petroleum products, burning of refuse and from domestic burning of fuels. As it is highly reactive, SO_2 has a highly non-uniform dose distribution along the conductive airways of the respiratory tract. Its inhalation by humans will lead to increase breathing rate and feeling of air-starvation; suffocation; aggravation of asthma and bronchitis; impairment of pulmonary functions, respiratory irritation; sensory irritation and the irritation of eyes and the throat. The gas is also associated with acid rain phenomenon in most Kenyan urban centres.

ii) Carbon monoxide (CO)

Natural ambient concentrations of CO range between 0.01- 0.23 mg/m^3 (WHO 1994). Concentration of CO can be high in vehicles, underground parks, power generators, road tunnels and in other indoor environments where combustion engines operate with inadequate ventilation. This is usually due to incomplete combustion of fuels.

Carbon Monoxide is a silent killer. It exerts its toxic effects after binding with haemoglobin in the capillaries of the lungs to form carboxyhaemoglobin (COHb). The affinity of haemoglobin for CO is 200-250 times that of oxygen. Formation of carboxyhaemoglobin impairs the release of oxygen from haemoglobin and these are main causes of tissue hypoxia. Severe hypoxia due to acute CO poisoning may cause both reversible, short-lasting, neurological deficits and severe, often delayed, neurological damage.

iii) Nitrogen dioxide (NO_2)

NO_2 is a relatively water-insoluble gas and appreciable amounts of inhaled NO_2 can penetrate the body and elicit biological responses along the respiratory track. Ambient concentrations in air are variable. The major sources of the gas are boilers, especially during the combustion of wood and refuse. As a pollutant, this oxide is known to cause

respiratory irritation, headache, bronchitis, emphysema, lung oedema and loss of appetite.

iv) Carbon Dioxide (CO_2)

Carbon dioxide that is only toxic at high levels is strongly associated with the phenomenon of climate change and global warming (green house effect).

v) Volatile Organic Compounds (VOCs)

Hydrocarbon (Volatile Organic Compounds) is a product of petroleum product and some hydrocarbons have shown some carcinogenic properties when inhaled.

3.3 Air Quality Measurement Methods

The measurements were undertaken using a Drager Tube Flue Gas Analyser. This is a direct reading instrument that has the capacity to measure and display the products of combustion from a domestic or commercial fossil fuelled appliance. It can also measure ambient air quality in rooms or buildings. The measurements are carried out by placing the probe at the general area in along proposed site and directly reading the levels of the parameters on the tubes.

3.3.1 Results of the air quality analysis

Table 3: Block 1 AIR QUALITY EMISSIONS

	Location	Carbon Monoxide (CO)	Sulphur Dioxide (SO_X)	Carbon Dioxide (CO_2)	Volatile Organic Compounds (VOC)	Remarks
1	Position ($X_{1)}$ North East location	Below detectable limit	Nil	0.68	Below detectable limit	Within the limit
2	Position (X_2) North centre	Below detectable limit	Nil	0.73	Below detectable limit	Within the limit
3	Position (X_3) North West location	Below detectable limit	Nil	0.74	Nil	Within the limit
4	Position (X_4) Middle West location	Below detectable limit	Nil	0.79	Nil	Within the limit
5	Position (X_5) Middle Middle	Nil	Nil	0.75	Nil	Within the limit
6	Position (X_6) South East location	Nil	Nil	0.76	Nil	Within the limit
7	Position (X_7) South Middle side	Below detectable limit	Nil	0.78	Below detectable limit	Within the limit
8	Position (X_8) South centre fence	Below detectable limit	Nil	0.76	Below detectable limit	Within the limit

	Location	Carbon Monoxide (CO)	Sulphur Dioxide (SO_X)	Carbon Dioxide (CO_2)	Volatile Organic Compounds (VOC)	Remarks
9	Position (X_9) South west location	Below detectable limit	Nil	0.56	Below detectable limit	Within the limit
*	**TLV**	**1.8ppm**	**0.191ppm**	**1.8ppm**	**6mg/m^3**	

Nil- *Means the emission does not exist at the sampling site*

Table 4: Block 2 AIR QUALITY EMISSIONS

	Location	Carbon Monoxide (CO)	Sulphur Dioxide (SO_X)	Carbon Dioxide (CO_2)	Volatile Organic Compounds (VOC)	Remarks
1	Position ($X_{1)}$ North East location	Below detectable limit	Nil	0.70	Below detectable limit	Within the limit
2	Position (X_2) North centre	Below detectable limit	Nil	0.72	Below detectable limit	Within the limit
3	Position (X_3) North West location	Below detectable limit	Nil	0.64	Nil	Within the limit
4	Position (X_4) Middle West location	Below detectable limit	Nil	0.69	Nil	Within the limit
5	Position (X_5) Middle Middle	Nil	Nil	0.65	Nil	Within the limit
6	Position (X_6) South East location	Nil	Nil	0.66	Nil	Within the limit
7	Position (X_7) South Middle side	Below detectable limit	Nil	0.68	Below detectable limit	Within the limit
8	Position (X_8) South centre fence	Below detectable limit	Nil	0.66	Below detectable limit	Within the limit
9	Position (X_9) South west location	Below detectable limit	Nil	0.59	Below detectable limit	Within the limit
*	**TLV**	**1.8ppm**	**0.191ppm**	**1.8ppm**	**6mg/m^3**	

Nil- *Means the emission does not exist at the sampling site*

3.3.2 Discussion of the results

The result of air emission indicates that the levels were within the limit. The low emissions show that there is no pollution at the proposed site.

4.0 AMBIENT NOISE LEVEL ASSESSMENT

4.1 Introduction

The ambient baseline noise levels survey was carried out at the proposed land development Project Site at Eldoret. The measurements were part of Strategic Environmental Assessment required by NEMA to establish Baseline Noise Levels data that can be used to control of noise pollution during land development phase.

The baseline noise level data obtained shall form the basis for comparison and control when mitigating the noise emission from the proposed development.

Currently, the noise emission is from wind, birds and animals at the site apart from Traffic noise along the site access road.

During the development and operation phases, the noise shall be reduced where practicable by following the rules and regulations set out in the relevant codes of practice, and by applying the mitigation provided in this report. The Environmental Management Plan (EMP) put into place shall include measures and targets for the control of noise. This approach will be necessary to minimize noise impacts to the nearest occupied buildings during the development phase and to ensure that the noise from development activities shall not affect operations in the neighbourhood or affect communication within the nearest occupied buildings.

Predictions of noise during development phase shows that the target noise levels shall be met and will not impact negatively to the environment and neighbours. The noise that will be generated during operation phase is not expected to impact negatively to the environment beyond 200m from the centre of the development after mitigation.

The effect of the development on the acoustic environment of the site and surrounding environment shall need to be investigated further during construction and operation phases.

It is predicted that road traffic noise along the access road shall be slightly elevated during construction since the traffic flow to the proposed development will increase and the noise levels will decrease after development.

The details of the baseline noise levels measurement results are presented in **Table 8 & 9** in this report.

4.2 Noise

- Noise can be defined as unwanted or undesirable sound derived from sources such as industrial set up and operations, road traffic, mining operations or construction.
- Noise can interferes with conversation and communication, sleep, recreation, general work performance, thought and concentration, relaxation, causes annoyance and induces hearing loss.

4.3 The exposure limit (benchmark)

After analysis, the noise levels obtained were compared with the standards [Threshold Limit Values (**TLV**),] set by Kenya Government and noise standards adopted by International Labour Organization (ILO), World Health Organization (WHO) and American Conference of Industrial Hygienist (ACGIH) 1989-guideline document.

4.3.1 Noise acceptability

When the measured background noise level is subtracted from the noise level measured at 1m from the façade of the nearest noise-sensitive property, the difference provides an indicator for the likelihood of complaint.

- A difference of around +10 dB or more indicates that complaints are likely.
- A difference of around +5 dB is of marginal significance.
- If the rating level is more than 10 dB below the measured background noise level then this is a positive indication that complaints are unlikely.

4.4 Baseline Noise Level and Vibration Assessment Methodology

4.4.1 Instrumentation

A precision integrating sound level meter type CR 262A S/No. B21122FA with Omni-directional microphone set at a slow response was used. The instrument was calibrated using Bruel and Kjaer sound level calibrator type 4230 for sound level meter at 94 dB (A) and 1000 Hz. The calibration was used to check the sensitivity of the instrument immediately before and after the measurement period.

The meter was set to measure the A-weighted noise level, which varies with the frequency and intensity like the sensitivity of the human ear and vibration.

The sound level meter was held at 1 metre from ground and $\mathbf{L}_{\mathbf{eq}}$ (the continuous equivalent sound pressure level) sample measurements at and around the proposed project road was taken. The $\mathbf{L}_{\mathbf{eq}}$ is indicative of the 'average' noise level over a given period. The measured baseline noise levels are presented in **Table 8 & 9** in this report.

4.5 Vibration

Vibration which is related to noise results from the transmission of low frequency energy through the medium of ground or buildings. It results in small movements of the transmitting medium, which can cause discomfort if the movements are large enough.

The proposed ICDC land is current empty and no activities going on and such there is no source of vibration . It is proposed that during development and construction equipment are at the land vibration measurement be carried out to assess the type of vibration exposure to the community.

4.6 Proposed Land Development

The main receptors of the proposed land development noise will be those properties adjacent to the project, i.e. the immediate neighbours.

Currently, the nearest neighbours are residential houses next to the proposed land development.

It is recommended that any construction plant brought to the site will comply with the relevant legislation noise limits applicable to that equipment or will not be noisier than would be expected based on the noise levels quoted in BS 5228:1987.

4.7 Identification of noise impact

The dominant noise source affecting the baseline noise levels at the proposed land development is from traffic accessing the site and people walking along the proposed land access road.

During development phase, the main source of noise will be from construction equipments, contractors and traffic accessing the site bringing construction materials. However, during operational phase, the main noise source will be from traffic travelling along the access road to the proposed land.

4.8 Predication of impacts

The predictive method was carried out in accordance with British Standard (BS 5228 Part 4, "Procedures for the assessment of noise at Open Construction Sites").

The following assumptions are made in the predictions:

- Noise propagation is assumed to be hemispherical and in free air;
- No attenuation from atmospheric or ground absorption is assumed;
- The intervening space between the development and the receptor points is acoustically reflecting hard ground;
- The predicted noise levels are those under neutral weather conditions;
- No barrier attenuation is assumed.
- Two JCB equipments and two trucks to ferry away the spoils shall be used at the site during development for eight hours per day.

The noise assessment approach follows two lines:

- First, assessment of baseline noise levels at target noise levels for the identified receptor location, which the contractors shall be required to address in setting out their methods of working.
- Second, use of predictions for the development activities that are likely to transmit noise to the community.

4.9 Development Phase

As mentioned earlier, the main source of noise is from construction equipments and traffic accessing the development site bringing building material. The other source of noise is from construction workers. The noise impact from each source is tabulated in Table 3 below:

The target noise levels during development are set at 85 dB (A) during the day and the 70 dB(A) at night, *(NEMA&WHO)*. This noise level limit relates to noise from the construction equipment and traffic accessing the site at a point 1m in front of the facade of any occupied building.

The Emphasis of the assessment is focused on the noisiest phases of work, which is likely to arise from the use of equipment such as JCB, a wheeled loading shovel, Tipper lorries for soil removal, dump truck, trucked excavator, Such construction equipments noise levels are quoted in BS 5228 Part 1: 1997.

The predication of the expected noise level impacts during the two key phases of work, i.e.:

- Removal of the vegetation and top soil
- Excavation,

The breakdown of the plant inventories assumed for each stage of the construction processes are presented in **Table 5.**

TABLE 5: INVENTORIES OF PLANT FOR KEY CONSTRUCTION STAGES

Construction, excavation and drilling plants	**Plants' noise level $L_{A\ eq\ at\ 10m}$ dB**	**Number of plants assumed to be at the site at a time**	**On-time (hr)**
JCB plant 1	80	1	8
JCB plant 2	83	1	8
Tipper lorry	86	2	6
Dump truck	72	3	6
Note: **Source BS 5228 part 1 1997**			

When all the equipments will be operating at the proposed construction site, the combined resultant noise level is obtained using the **Table 6** below:

TABLE 6 : ADDITION OF STEADY LEVELS

Difference between the two levels dB(A)	Addition to the higher level dB(A)
O	3
1	3
2	2
3	2
4	1

Difference between the two levels dB(A)	Addition to the higher level dB(A)
5	1
6	1
7	1
8	1
9	1
10 and above	0

The general formula for the combination of two sound levels dB_1 and dB_2 is:
$dB_{Total} = 10\log_{10}(10^{dB_1/10} + 10^{dB_2/10})$
Source BS 5228 part 1 1997

Using the table or the formula above, the combined noise produced by all the equipment will be at the rate of 88dB(A). This noise level is above the target noise level of 70 dB(A) *NEMA*. To meet the expected target level, noise mitigation must be carried out.

4.10 During Operation Phase

During operation, the main source of noise is the traffic travelling to the project site. The traffic noise level is 72dB(A) and people passing the noise level is 54dB(A) The combination of these noise levels will be 72dB(A) and will be within the ambient noise levels set by Kenya Government for traffic at the construction site.

To meet the target noise levels, it is recommended that No residential building should be within 200meters from the centre of the proposed development during development.

Reference: **Source BS 5228 part 1 1997**

4.11 Logistic framework

The impact noise from to the proposed project is subject to the following registrations:

1) Legal Notice No. 61- The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.
2) Legal Notice No. 25- The Factories and Other Places of Work (Noise Prevention and Control) Rules, 2005.
3) WHO Guidelines for Community Noise (http:/www.who.int/docstore/peh/noise/comnoiseExec.htm).
4) BS 5228 Part 1: 1997-Noise and Vibration control on construction and open sites.

The comparison of various Standards is presented in **Table 7** below.

Table 7: Noise comparison between **WHO, NEMA** and **DOSHS** Regulations

Specific Environment	Critical Health Effects	L_{Aeq} dB(A) WHO	Time base (hours)	L_{Aeq} dB(A) NEMA LN 61	Time base (hours)	L_{Aeq} dB(A) DOSHS LN 25
Outdoor living area	Serious	55	16	45	14	-

Specific Environment	Critical Health Effects	L_{Aeq} dB(A) WHO	Time base (hours)	L_{Aeq} dB(A) NEMA LN 61	Time base (hours)	L_{Aeq} dB(A) DOSHS LN 25
	annoyance Moderate annoyance	50	16	35	14	
Indoor dwelling Inside bedroom	Speech interference Sleep disturbance	35 30	16 8	-	-	-
Outdoor bedroom	Sleep disturbance	45	8	35	-	-
School classroom Indoor	Speech and communication	35	During class period	Day 60 Night 35	14 14	-
School playground outdoor	Annoyance External	55	During play	45	During day	-
Hospital, treatment room indoor	Sleep disturbance night time during day and	30 30	8 16	-	-	-
Industrial, Commercial and traffic areas	Hearing impairment	70	24	60	12	-
Ceremonies, festivals entertainment events	Hearing impairment	100	4	-	-	-
Public address system indoor and outdoor	Hearing impairment	85	1	-	-	-
Occupational workplace	Hearing impairment	90	8	90	8	90
Impulse noise from toys, firearms, fireworks	Hearing impairment	140	-		-	140
Traffic accelerating	Hearing impairment	-	-	84	-	-
Construction site	-	-		60	14	90
Other areas, Factories	Hearing impairment	90	8	75	14	90

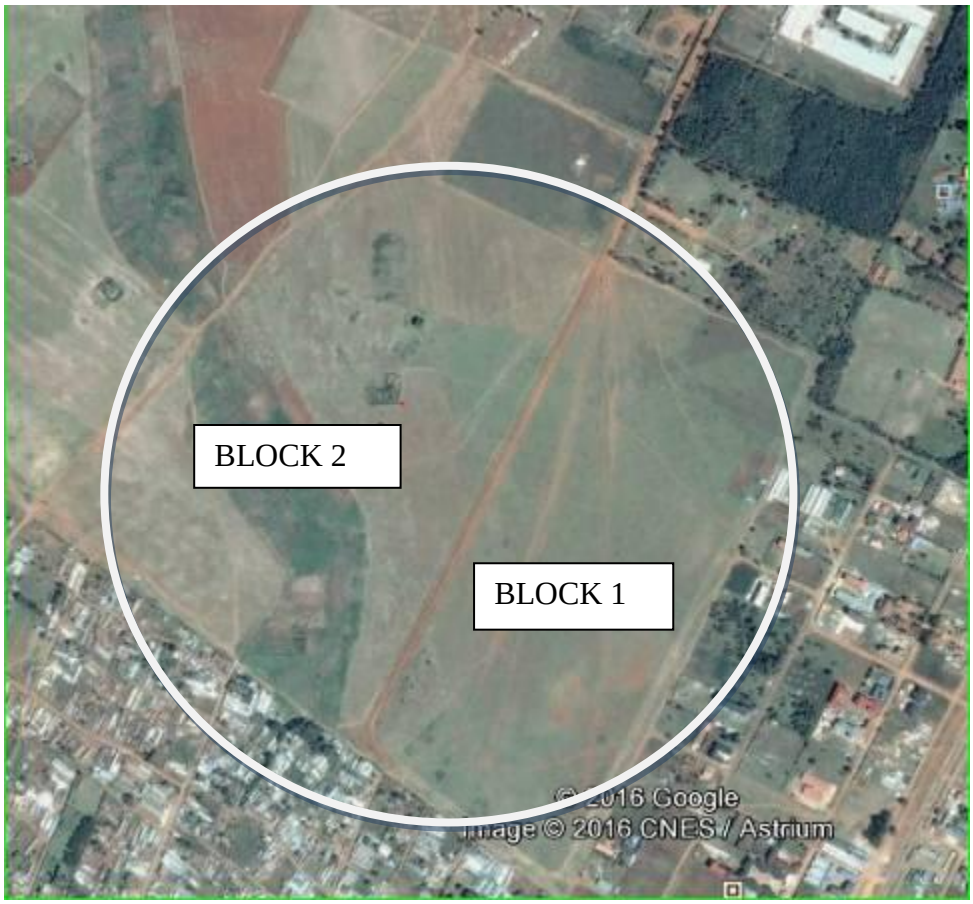

Plate 2: The proposed site for Development

4.12 Project locations

The project locations are within Eldoret Municipality and the noise to be transmitted to the community by the construction activities will be attenuated by distance from the construction site to the nearest occupied property. To minimize the noise pollution to the community, the contractor and their sub-contractors should comply with all legislation relevant to the control of noises and other environmental impacts from construction activities as directed but not limited by:

- Environmental Management and Coordination Act (EMCA).
- Occupational Safety and Health Act Cap. 514 and its Subsidiary Legislations.
- The Building by-laws of Kenya.

4.13 Literature review

i) Attenuation by distance

Sound, which propagates from a point source in free air, attenuates by 6 dB for each doubling of the distance from the noise source. Sound propagating indoors is attenuated less than this value; because of contributions to the total sound level from reverberant sound brought about by reflection from walls and ceilings. This is not always possible if the work takes place on a restricted site or fixed structures such as railway trucks, petrol stations and pipe lines.

ii) Traffic Noise

This is the traffic noise that will be emitted by traffic accessing the development site during construction, operational and decommissioning phases. Traffic Noise propagates from a line source and as a general guide, an increase of 25% in traffic volume approximates to a noise level increase of around 1 dB, while a doubling of traffic volume results in a noise level increase of about 3 dB. A guideline of 1 dB rise in road noise is adopted as indicating a potentially significant noise increase due to traffic.

4.14 Ambient Noise Survey

4.14.1 Results Ambient Noise Level measurement

TABLE 8 :Noise Levels survey (BLOCK 1)

#	POSITION	Measured noise levels Leq dB(A)		TLV	REMARKS
		LeqMin	LeqMax		
1	Position ($X_{1)}$ North East location	29.4	43.6	**75**	Within the limit
2	Position (X_2) North centre	35.0	50.7	**75**	Within the limit
3	Position (X_3) North West location	27.0	49.9	**75**	Wind

#	POSITION	Measured noise levels Leq dB(A)		TLV	REMARKS
4	Position (X_4) Middle West location	29.6	55.5	**75**	Wind
5	Position (X_5) Middle Middle	30.6	57.0	**75**	Wind
6	Position (X_6) South East location	34.2	57.0	**75**	Wind
7	Position (X_7) South Middle side	34.8	55.5	**75**	Wind/traffic
8	Position (X_8) South centre fence	33.8	65.5	**75**	Traffic Noise
9	Position (X_9) South west location	51.9	63.3	**75**	Within the limit

TABLE 9: Noise Levels survey (BLOCK 2)

#	POSITION	Measured noise levels Leq dB(A)		TLV	REMARKS
		LeqMin	LeqMax		
1	Position ($X_{1)}$ North East location	39.4	44.6	**75**	Within the limit
2	Position (X_2) North centre	34.0	51.7	**75**	Within the limit
3	Position (X_3) North West location	27.3	48.9	**75**	Wind
4	Position (X_4) Middle West location	39.6	54.5	**75**	Wind
5	Position (X_5) Middle Middle	31.6	53.0	**75**	Wind
6	Position (X_6) South East location	34.4	52.0	**75**	Wind
7	Position (X_7) South Middle side	35.8	56.5	**75**	Wind/traffic
8	Position (X_8) South centre fence	35.8	55.5	**75**	Traffic Noise
9	Position (X_9) South west	54.9	63.3	**75**	Within the limit

#	POSITION	Measured noise levels Leq dB(A)		TLV	REMARKS
	location				

4.14.2 Data analysis

The ambient noise levels at the proposed development site and its environ was between 27.0dB(A) and 51.1dB(A) which is within the NEMA Noise and Vibration limit set for commercial zone. The target noise level is set at 75dB(A) at the construction site.

4.15 Noise abatement and mitigations

Methods to mitigate road construction noise are described in general terms. The key point is that the measures should be incorporated within the Road Construction Project Environment Management Plan, which will form the basis for the mitigation of the noise emission.

Prior to the commencement of the work at the proposed site, all relevant laws and regulations shall be consulted. This will confirm the noise control limits in line with target noise levels, set out, hours of working and give further detail on the types of construction activities that may be undertaken.

The relevant laws and regulations will also set out a dispensation procedure under which consent can be applied to carry out works which it is considered will exceed the agreed noise and vibration limits or must occur at times when such work is not permitted. The following instruction should be obeyed:

No plant will be allowed to start or to move on site nor any work to commence before 07.00 hours, except in case of emergency where safety is an issue or as agreed under a dispensation.

Works audible beyond the site boundary will be undertaken outside the hours specified above except in case of emergency where safety is an issue or under a dispensation as specified in the relevant regulations.

All movable Plants shall be properly maintained and operated in accordance with manufacturer's recommendations.

All mechanically powered plants will be fitted with suitable silencers.

All stationary plants will be suitably located such that the noise impact at all the occupied properties will be minimized.

The contractor and their sub-contractors will at all times apply the principle of Best Practicable Means and will carry out all works in such a manner as to reduce any disturbance from noise and vibration to a minimum.

4.15.1 Impacts and mitigation

4.15.1.1 Construction Phase

The proposed development project noise has a potential to disturb users of the residential houses next to the proposed Road Project. The noise level of JCBs and the trucks working together is 88 dB(A). The noise levels that will be emitted by the equipment to the nearest neighbour are expected to be within the accepted limit for road traffic after mitigation.

Predicted noise emissions from the JCB equipment and trucks that will be operating during construction phase are presented in **Table 10.**

Prediction of the noise emissions from different activities along the road during construction show that the target noise levels shall be met at key receptors.

TABLE 10 : PREDICTED NOISE EMISSIONS DURING CONSTRUCTION PHASE

Types of plants	Plant noise levels L_{Aeq} dB (A) at 10m	Number of plants at the site	On – time (hrs)
JCB Equipments	85	3	8
Trucks to carry spoils	86	5	6
Control office activities	55	-	8
Combined sound levels	**88**	**-**	**8**

Source: BS 5228 Part 1 1997

4.15.1.2 Operation phase

During operation phase, different sources of noise will be emitted by workers and traffic travelling along the road. To mitigate noise pollution and to avoid community exposure, unnecessary hooting and revving should be should be discouraged within 200m from the occupied building.

BS 5228 Part 1 1997

4.16 Noise Risk Assessment Analysis

4.16.1 Construction phase

Table 11: Risks

Unmitigated Impact: Noise above 75dB(A)	
Extent of impact	2
Magnitude	4
Duration of impact	1
Probability of occurrence	2
Result	**14**
Comment/mitigation	
1	Follow the rules and regulations set out in the relevant codes of practice and instructions contained in the Environmental Management Plan (EMP) and Construction Environmental Plan (CEP)
2	Use protective equipment

3	Maintain equipment and plant

Mitigated Impact: Noise above 75dB(A)	
Extent of impact	1
Magnitude	2
Duration of impact	1
Probability of occurrence	2
Result	**8**
Comment/mitigation	
1	Maintained the fence around the site
2	Maintenance personnel to use ear defenders always they are at the site
3	Maintain the equipment and plant

4.16.2 Operation phase

Table 12: Risks

Unmitigated Impact: Noise above 75dB(A)	
Extent of impact	1
Magnitude	2
Duration of impact	3
Probability of occurrence	2
Result	**12**
Comment/mitigation	
1	Driving without hooting unnecessary
2	Avoiding building within 200m from the highway

Mitigated Impact: Noise above 70 dB(A)	
Extent of impact	1
Magnitude	2
Duration of impact	3
Probability of occurrence	1
Result	**6**

Comment/mitigation	
1	Driving without hooting unnecessary
2	Truck drivers accessing the site during operation to avoid unnecessary hooting and accelerating their vehicles
3	Avoiding building within 200m from the highway

4.17 Risk matrix

EIA STUDY RISK MATRIX

EXTENT			MAGNITUDE	
Localized (At localized scale and a few hectares in extent)	**1**		Small and will have no effect on the environment	**0**
Study area (The proposed site and its immediate environs)	**2**		Minor and will not result in an impact on the processes	**2**
Regional (District and provincial level)	**3**		Low and will cause a slight impact on the processes	**4**
National (Country)	**4**		Moderate and will result in process continuing but in a modified way	**6**
International (Beyond Kenya)	**5**		High (processes are altered to the extent that they temporarily cease)	**8**
			Very high and results in complete destruction of patterns and permanent cessation of the processes	**10**

DURATION			**PROBABILITY**	
Very short (0 – 1 Years)	**1**		Highly improbable (<20% chance of occurring)	**1**
Short (1 – 5 Years)	**2**		Improbable (20 – 40% chance of occurring)	**2**
Medium term (5 – 15 years)	**3**		Probable (40% - 70% chance of occurring)	**3**
Long term (>15 years)	**4**		Highly probable (>70% - 90% chance of occurring)	**4**
Permanent	**5**		Definite (>90% chance of occurring)	**5**

4.18 Method used to determine the environmental risk

Risk = (Extent+Duration+Magnitude) x Probability

		CONSEQUENCE (Extent+Duration+Magnitude)																			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
PROBABILITY	**1**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
	3	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	4	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
	5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100

Low	<30	Where this impact would not have a direct influence on the decision to develop in the area
Medium	30-60	Where the impact could influence the decision to develop in the area unless it is effectively mitigated
High	>60	Where the impact must have an influence on the decision process to develop in the area

4.19 Confidence of assessment

The degree of confidence in predictions based on available information, Industrial Environment Management, judgment and/or specialist knowledge	High

4.20 Conclusions

4.20.1 Baseline noise

The baseline noise climate in the proposed road construction is a characteristic of rural set-up. The road traffic influences the noise environment around the proposed road project and the noise levels are expected to rise during construction and reduce after construction. The noise levels along the proposed road are expected to conform to NEMA Standards for accelerating traffic.

4.21 Construction Phase

Predictions of noise during construction phase indicate that the target noise levels at key receptors shall be achieved.

The most **significant vibration** sources are likely to come from the JCB Equipment vibrating rollers at the proposed site and the noise emissions are expected increase above the current ambient levels within the site.

Measures shall be taken to reduce noise levels where practicable by following the rules and regulations set out in the relevant codes of practice and a construction Environmental Plan will be put into place, which will include measures and targets for the control of noise. This approach will be necessary to minimize impacts on residential houses next to the proposed service station.

4.22 Operational phase

The effect of the road construction to the acoustic environment of the surrounding area shall need to be investigated to find out if the target noise levels shall have been achieved during operation phase.

The community surrounding the site will not be negatively affected by proposed road construction.

The noise emissions from the proposed construction are predicted to be within the accepted limits for all occupied residential building beyond 200m away.

4.23 Road traffic Noise (RTN)

Changes in the traffic flow along the construction site are not predicted to increase during operation phase.

4.24 Environmental Management Plan

Table 13 EMP Matrix

	Impacts	Mitigation	Estimated cost in Ksh.	Responsible	Time Frame
During construction					
	Body injuries to workers	Provide protective equipment	50,000.00	Contractor	Immediate construction works start
	Environmental pollution	Control traffic speed and spray water on loose soil	100,000.00	Contractor	During construction phase -
During operation phase					
	Noise impact	Control traffic speed	75,000.00	Management	During operation phase
	Noise Audit	Carry out noise survey during operation phase	60,000.00	Management	During operation phase

5.0 GENERAL CONCLUSION AND OBSERVATION

The dust seen on tree leaves and on top of neighbouring buildings is not a risk to health as it is not inhalable.

The results of the measurements indicate that there is no environmental air pollution or health risk to humans and the present air quality levels standards should be maintained as far as reasonably practically during construction phase.

6.0 RECOMMENDATIONS

Another survey should be done after construction phase to assess the operational emissions to the environment.

REFERENCES

1. ILO encyclopedia of Occupational Health and Safety Vol. II, Geneva 1983.
2. Barbara A. Plog*, et el.*, Fundamentals of Industrial hygiene, 3rd Edition, National Safety Council, 444 North Michigan Avenue, 1988.
3. BS 5228 Part 1: 1997
4. The Environmental Management and Coordination (Air Quality) Regulations 2014

Signature of Approved Person

Albert W. Muriuki MSc (Occ. Hgy.) UK.
NEMA Registered EIA Lead Expert/ Safety and Health Adviser
Tehilla Company Limited

Dated 09/04/2016

APPENDIX 1- PHOTOGRAPHIC REPORT

Pictures of the proposed Eldoret ICDC land	Description
	**Plate 1** Proposed Land for development
	**Plate 2** Proposed Land Showing neighbours
	**Plate 3** Proposed land Eastern Side neighbours

	**Plate 4** Proposed Land Southern side neighbours
	**Plate 5** Proposed land showing domestic animal grazing at BLOCK 2
	**Plate 6** Proposed land access Road

APPENDIX 2 Air Quality Monitor Certificate

MLSSS/DOSH 4

REPUBLIC OF KENYA

The Occupational Safety and Health Act, 2007

CERTIFICATE OF APPROVAL OF AIR QUALITY MONITOR

I hereby approve **Mr. Albert Wacira Muriuki,** holder of **National ID No. 0236360** of P.O. Box **60139 - 00200 Nairobi,** to carry out **Air Quality Measurements** of workplaces for the purpose of Rules16 and 17 as read with Rule 2 of Factories and Other Places of Work (Hazardous Substances) Rules (Legal Notice No. 60/2007) under the Occupational Safety and Health Act, 2007, Laws of Kenya.

This certificate is valid from **1st July 2015** to **30th June 2016**, unless revoked by the Director of Occupational Safety and Health Services any time earlier.

Certificate No. **OSH / AQM 001**

Date of Issue... 9-7-2015...

Director of
Occupational Safety
and Health Services

Conditions

1. The authority to carry out air quality monitoring cannot be delegated.
2. This certificate does not allow the holder to carry out Air Quality Monitoring in his/her place of work or employment
3. The holder of this approval certificate must continually upraise her/himself of the safety and health legislation in this country.
4. The holder of this approval certificate undertakes to notify the director's office of any air quality measurements two weeks prior to executing the said work
5. A copy of the report of the results of measurements must be sent to the relevant offices of the DOSHS within fourteen days of the completion of measurements.
6. To verify the authenticity of this certificate the occupier should endeavour to visit www.doshs.go.ke the official website of the Directorate of Occupational Safety and Health Services or call 0202667722 for the updated list of approved Air Quality Monitors.

Signature of Approved Person

Date... 08/08/15...