

Evaluation of Environmental Noise Level of Pollution in Baghdad City**Basim Abdulsattar Hussain****Jawad Abdulkadhim Al-aboudi****Adnan Hasan Afaj**

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E-mail: basimsaidi@hotmail.com**Abstract**

The capital city of Iraq (Baghdad) recently has been exposed to many uncontrolled noise sources, due to the fast economical development and population growth, vehicles, electric generators, industrial and commercial activities. In this study, noise level was investigated in residential, commercial and industrial areas. Measurements implemented in 51 selected locations. Equivalent noise levels are calculated and compared with noise level at the international standard limits. The study identifies the noise sources in each region. Noise measurements were taken at different day and night times, calculations conducted to obtain the equivalent and average representative noise level. The measured noise level exceeded the recommended standards limits for good health and environment especially in locations that suppose to have a silence zone such as parks and hospitals. Noise level at the industrial areas was as higher as 102 dB. Continuous exposure at these locations (8 daily working hours) without any precautions or occupational safety actions will certainly leads to adverse health effects to workers and individuals.

Key words: Noise, Pollution, Evaluation, Environmental and Baghdad City.

تقييم مستوى التلوث البيئي الضوضائي في مدينة بغداد

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الخلاصة

تعرضت العاصمة العراقية (بغداد) في الآونة الأخيرة إلى مصادر مختلفة من الضوضاء التي يصعب السيطرة عليها بسبب زيادة عدد السكان والنمو الاقتصادي السريع، مركبات النقل، المولدات الكهربائية وممارسة الأعمال التجارية والصناعية. في هذه الدراسة تم التحقق من مستوى الضوضاء في المناطق السكنية والتجارية والصناعية. نفذت أعمال القياس في 51 موقع مختار، تم حساب ومقارنة مستوى الضوضاء المكافئ مع المحددات الدولية. عرفت الدراسة أيضاً مصادر الضوضاء في كل منطقة. نفذت معظم القياسات خلال فترات الليل والنهار. أجريت الحسابات اللازمة لغرض الحصول على مستويات الضوضاء المكافئة والتمثيلية. تبين أن مستوى الضوضاء يزيد عن المحددات والتوصيات المطلوبة من أجل بيئة وصحة جيدة خصوصاً في المناطق التي يفترض أن تكون أكثر هدوءاً مثل المستشفيات والمنتزهات. مستوى الضوضاء في المناطق الصناعية بلغ 102 dB. إن التعرض المستمر إلى هذا المستوى خلال فترات العمل (8 ساعات يومياً) وبدون استخدام وسائل الصحة والسلامة المهنية يقود إلى آثار صحية سلبية على العاملين والأفراد.

الكلمات المفتاحية: ضوضاء، تلوث، تقييم، بيئي ومدينة بغداد.

Introduction

Environmental noise can be defined as an unwanted or harmful outdoor sound created by different human activities which produce unordered high-level sound (Abdel-Razia *et al.*, 2000 ; Diniz and Zannin, 2004). Noise pollution adverse effects depend on exposure time, volume, and frequency of sound (Barber *et al.*, 2010). Sudden and high-level sound burst could leads to fatal damage on auditory system. The health effects of noise pollution have been studied by many researchers (Cohen *et al.*, 1986; Foreman *et al.*, 1998). The noise effect on human health includes physical effects as hearing defects, physiological effects as increasing blood pressure (Abdel-Razia and Mohammed, 2003; Jarup *et al.*, 2008). Irregularity of heart rhythms which known as palpitation (Passchier, 2000), psychological effects as sleeplessness, irritability, stress and effects on the work performance as reduction of productivity and misunderstanding what is heard (Evans and Hygge, 2000). The population of Baghdad (approximately 7,216,040) continue to increases year by year, with a growth rate up to 2.49% , making it the largest city in Iraq, the second largest city in the Arab World after Cairo, Egypt and the second largest city in Western Asia after Tehran, Iran.

There are three main aims for this study:

- To conduct an assessment and an evaluation of the noise levels in the city of Baghdad and to determine their sources.
- To calculate the residential, commercial and industrial noise levels.
- To carry out a comparative assessment of noise levels in Baghdad and implement a noise map using GIS spatial analysis of noise pollution.

Materials and Methods

During this study an evaluation, monitoring and analysis of environmental noise pollution was conducted in Baghdad for the period between July to December 2012, 51 locations were selected to cover most of Baghdad area representing its residential, commercial and industrial regions. Figure (1) shows the selected locations/zones for the noise pollution evaluation. The geographical distribution of noise level contours lines was made using the required spatial analysis tools of geographical information system (GIS) software version 10. Noise levels in (A) weighting characteristics (simulate human ear listening) to meet IEC 61672 class 2 requirements for environmental studies was measured using sound level meter (Lurton - Model SL-4112). The meter held 1.3 to 1.5 m above the ground surface and 3.0 to 3.5 m away from reflecting surfaces. The meter range is (30–130) dB (A), the devise was calibrated using an external sound calibrator (SC-941). For each sampling location, noise measurement was carried out continuously for a time of 15 minutes and repeated for 5 times at each location.

Definitions of Noise Parameters

Various noise pollution indicators were calculated using Gaussian percentile to obtain the noise pollution levels. Different percentile values like L_{min} , L_{max} , L_{av} , and L_{eq} levels were computed from the sample data to be used for the evaluation of noise levels. Equation (1) used to compute noise pollution indicators (Passchier, 2000).

$$L_{av} = (L_1 + L_2 + \dots + L_N) / N \quad \dots (1)$$

Where:

N: Number of measurements.

Equivalent continuous noise level (L_{eq}) has the same energy as the original

fluctuating noise for the same given period of time, equation (2) used to calculate this value (Passchier, 2000).

$$L_{eq} = 10 \text{Log}_{10} \left(10^{L1/10} + 10^{L2/10} + \dots + 10^{Ln/10} \right) / N \dots\dots\dots (2)$$

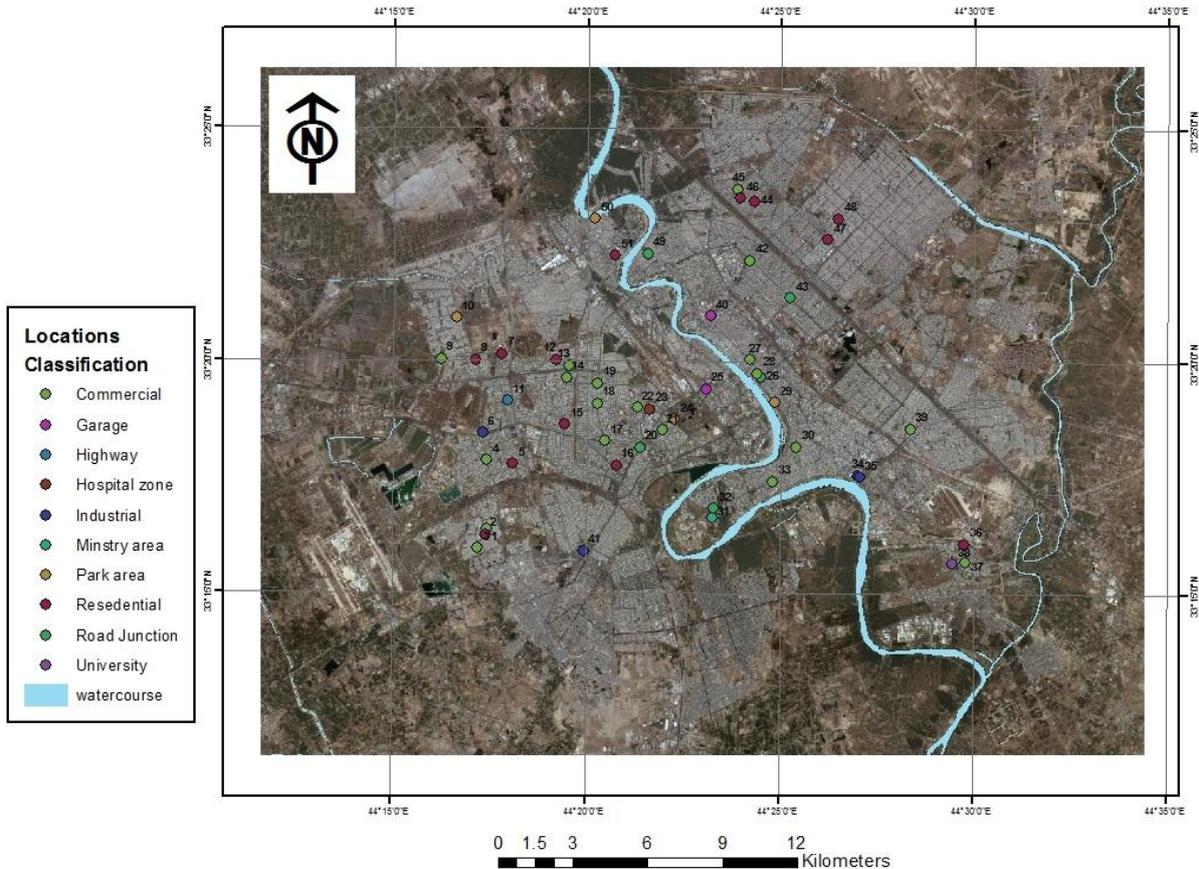


Figure (1) The Selected Locations/Zones in Baghdad

Results and Discussion

Basic calculations were applied to evaluate noise dose and L_{eq} . The results for complete data set of noise pollution levels in all locations assented in one format, mean and average, to compute and compare the equivalent values. L_{eq} values between (43.4–102.2) dB (A) for all locations. The overall noise levels for most of residential areas at night was much higher than the day time, the reason behind that, is that during night time most of the residential houses utilize generators to provide electricity and the combined noise coming from all generators would increase the overall noise level pollution. Figure (2) showed the residential day and night time noise levels. Noise levels in low density residential areas was

significantly much lower than highly populated areas due to large spaces, opening area and gardens, nevertheless, they all exceeded the noise standard limits in residential areas. Noise levels in highly populated and active commercial streets, exceeded 72 dB at all times and they are classified as noisy areas. Measured noise level in garages and parking areas classified as extremely high levels noise areas, noise sources at such places came from human activities, vehicles and open markets (shouting and loudspeakers noises). Industrial noise was measured by selecting four locations as shown in Figure (3), noise level in AL-Byaa industrial area exceeded 102 dB at morning activity time, this level considered as extremely dangerous to

human health as the normal daily working period at such location is 8 hours and most of the workshops did not follow any safety actions to protect workers. The second location was the oil-manufacturing factory located at city

center, the factory contains a number of machines and equipments that produces various noise levels, the measured average noise level was 86 dB inside the factory and as much as 76 dB outside the factory.

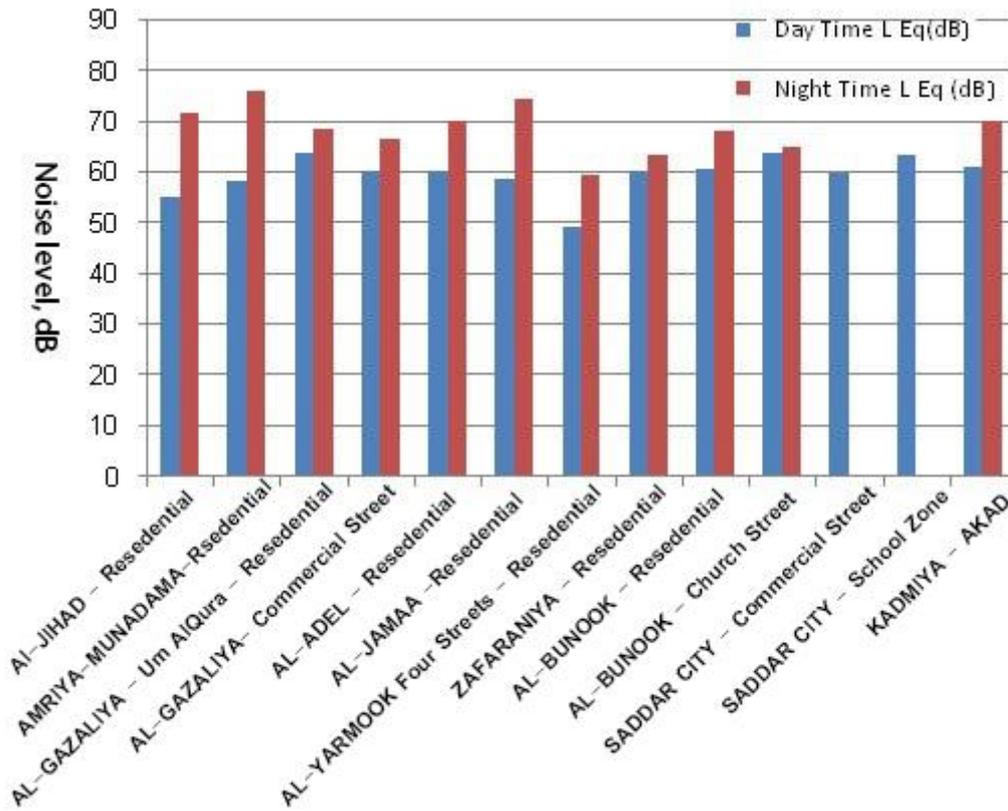


Figure (2) Residential Equivalent Noise Levels in Baghdad City

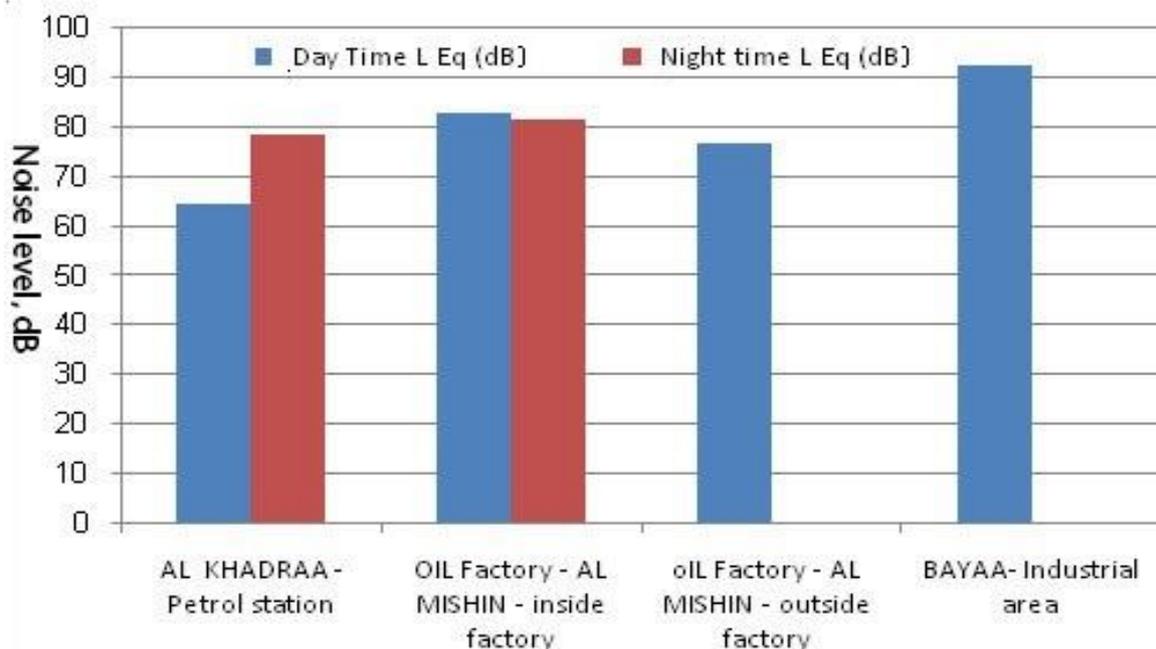


Figure (3) Industrial Areas Equivalent Noise Levels in Baghdad city

The study clearly identified that the major noises in residential areas are came from electric generators, a combination of traffic noise and human activities. Traffic also causes high levels of noise in the commercial areas. Industrial noise source came generally from the machines and equipments in the workshops and factories. Mean day time noise levels are calculated for residential, commercial and industrial areas , all values exceeding the limits by the WHO (WHO, 1999) and measurements in Vancouver city (Victoria, 2004) as shown in table (1).

L_{eq} noise levels at day and night times for each zone are shown in Figure (4). Noise maps for Baghdad was drawn using measured and calculated noise levels shown in Figures (5, 6 and 7). Maps showed that there was a mix between the residential, commercial and industrial zones as these zones did not separated by enough spaces, this makes the classification of the zone rather difficult , yet by looking at the maps legend and color density of the noise levels in these figures it clearly showed the amount and values of noise levels in the different sectors of the city .

Table (1) Mean noise for measured zones compared with WHO limits and Vancouver city

Zone	Measured mean noise level (L_{eq}), dB		Noise level in Vancouver city, (L_{eq}), dB		WHO limits, dB	
	Day time	Night time	Day time	Night time	Day time	Night time
Residential	59.77	68.58	55	50	55	45
Commercial	69.36	75.78	60	-	55	65
Industrial zone	79.05	-	-	-		
Parks and rests	53.97	76.49	-	-		
Road junctions	67.57	-	67	60		
Public garages	86.54	-	70	-		

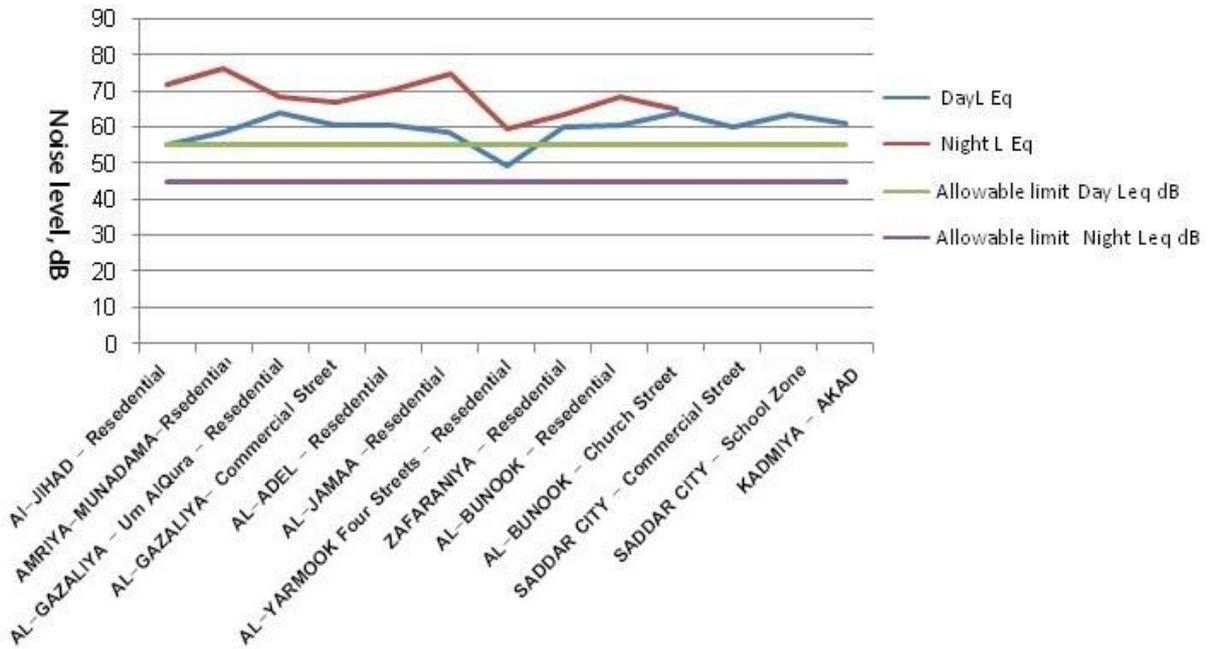


Figure (4) Day and Night Times Noise level Equivalents.

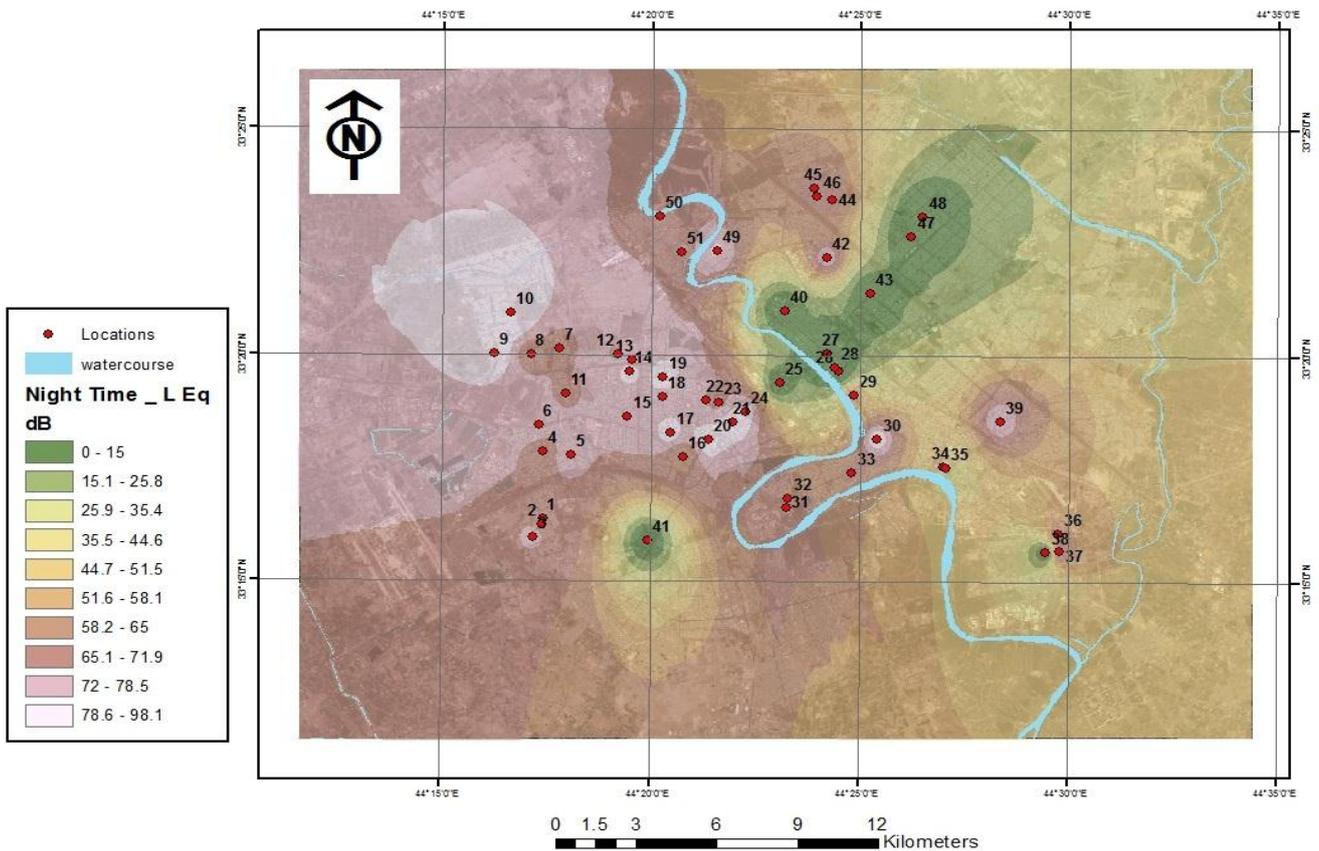


Fig (5) Baghdad City Noise Map

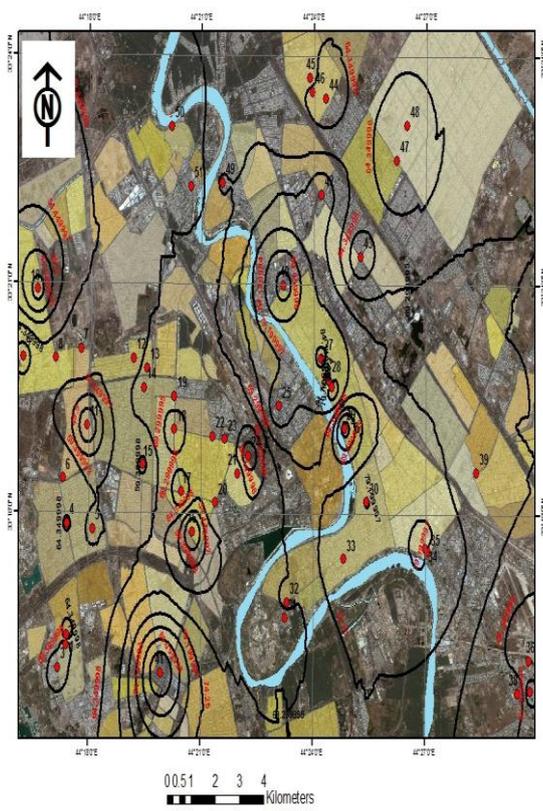


Fig (6) Baghdad City Day Time Noise Contours Map

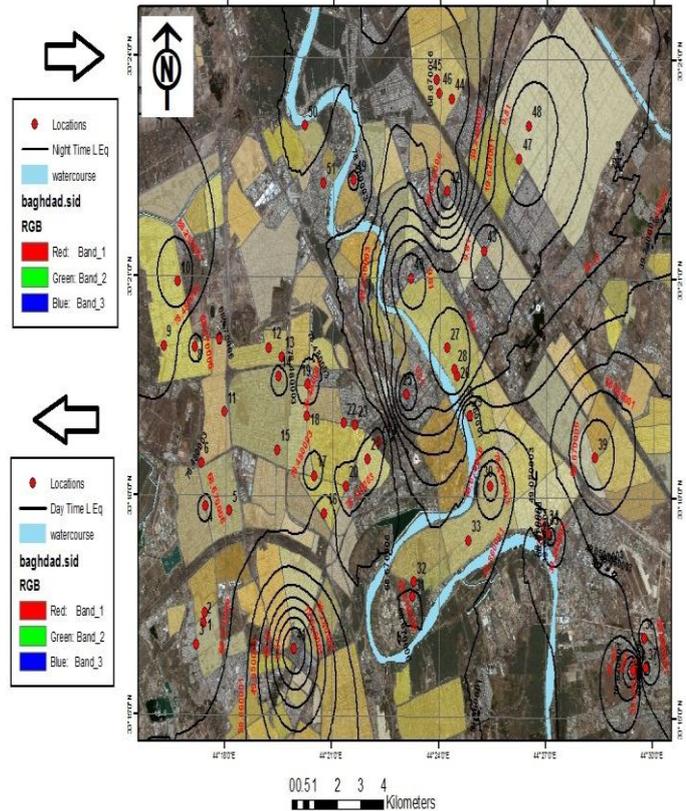


Fig (7) Baghdad City Night Time Noise Contours Map

Conclusions and Recommendations

Results show that the capital city of Baghdad is a noisy city, as there are no local standard limits for noise exposure, the problem is going to be worse during the coming years. Most of the noise measurements in this study exceeded the international standard limits. Noise sources in Baghdad are a combination of traffic and human activity noise. The randomly distributed electric generators of different capacities and without the use of silencers or sound proof containers have made the noise level exceeded to higher levels. The high traffic jams due to the rapid increase in number of vehicles and the absence of civilized plans for adding new roads with standard construction of noise preventers and barriers will increase the noise levels. Workers who are exposed to continuous high-level noise for more than 8 daily working hours will certainly leads to negative effects on workers health, productivity and performance. The study recommends

workers health , productivity and that further detailed studies and investigations are required for monitoring, measuring and controlling noise levels. Local standard limits, rules and legislations that enforce noise level exposure reduction must be issue. Workers should be aware of the consequences of continuous exposure to high level noise.

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