

## Noise levels Assessment in Selected Places in Al-Diwaniyah City, Iraq

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### Abstract:

Nowadays, noise becomes one of the most environmental pollutants. Several adverse effects linked with exposure to environmental noise. The aim of this study was achieved to evaluate noise level in some selected area represented by schools and medical centres in Al-Diwaniyah city according to the international standards. Therefore, noise levels were measured using sound level meters type (SVAN-955) in 10 places (5 schools and 5 health centres and hospitals) in different areas in the city. Most of these selected schools and health centres were exposed to noise from road traffic. The study revealed that equivalent sound level and minimum sound level for the schools (65dBA, 59dBA respectively) exceeded the international standards. The equivalent and minimum noise level in the health centres were (66dBA, 59.6dBA) also exceeded the WHO, USEPA and European legislations. Therefore, these results will be of help to planners and policy makers in the City to combat such this problem and Take the necessary actions to legislate the Iraqi standard for noise exposure and also to reduce the impact of noise on the buildings and common places.

**Keywords:** Sound level, Al-Diwaniyah, Schools, Health centres, Noise Pollution.

### تقييم مستوى الضوضاء لاماكن مختارة في مدينة الديوانية في العراق

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### الخلاصة

في ايامنا هذه, اصبح الضجيج (الضوضاء) من اكثر الملوثات البيئية تعقيدا, هنالك العديد من صلات الربط والعلاقة بين التأثيرات السلبية على الصحة والبيئة وبين التعرض للضوضاء. لذلك فان الغرض والهدف من هذه الدراسة هو لتقييم مستوى الضوضاء في اماكن مختارة من مدينة الديوانية متمثلة بمجموعة من المدارس ومجموعة اخرى من المراكز الصحية والمستشفيات وفقا للمعايير والمواصفات الدولية. ولذلك فان مستويات الضوضاء قد تم قياسها باستخدام مقياس مستوى الصوت نوع (SVAN-955) في عشرة اماكن ( بضمنها خمسة مدارس وخمسة مراكز صحية أو مستشفيات). معظم هذه الاماكن ( المختارة) تتعرض للضوضاء نتيجة لحركة ومرور السيارات . بينت نتائج هذه الدراسة ان مستوى الصوت المكافئ والحد الادنى لمستوى للصوت في المدارس كان بمعدل 65dBA و 59dBA على التوالي والتي تجاوزت الحدود والمواصفات الدولية. بالاضافة الى ذلك, فقد كشفت النتائج

عن ان مستوى الصوت المكافئ وكذلك الحد الأدنى لمستوى للصوت في المراكز الصحية والمستشفيات قد تخطى حدود مواصفات منظمة الصحة العالمية والمواصفات البريطانية ومنظمة حماية البيئة الاميركية وبواقع 66dBA و 59.6dBA على التوالي. وبناء على ما تقدم فان مثل هذه النتائج تساعد اصحاب القرار والمخططين لاتخاذ الاجراءات والتدابير الضرورية والتي من شأنها الحد من التعرض للضوضاء في تلك الاماكن وتشريع القوانين ووضع الحدود والمواصفات للتعرض للضوضاء في تلك الاماكن. بالإضافة الى دراسة امكانية دعم وتطوير البحوث واستخدام لمواد بناء واليات ووسائل بما يسهم من التقليل من تاثير تلك المستويات على تلك المؤسسات والاماكن العامة.

## 1. Introduction:

Contaminants which cause adverse change into the natural environment and can take the form of chemical substances or energy, such as noise, heat or light. "Nausea" is a Latin word means 'unwanted sound' or 'sound that is loud, unpleasant or unexpected where the word "noise" come from [1]. The unwanted sound is defined as a Noise. All the unwanted sounds in our communities except that which originates in the workplace represent environmental noise. Environmental noise pollution is a risk to health and well-being. Environmental noise is recognized as a major health problem[2]. The problems with noise pollution have often been given similar concern ratings as those for global warming especially in European Union (EU) [3]. Sound is the result of pressure variations in a medium – typically air. Pressure fluctuations above and below atmospheric pressure are detected by the human ear and this results in the sensation of hearing [4]. There are many concepts that providing a very useful mean of describing sound fluctuations. Sound is commonly measured using the decibel [dB] scale. In terms of environmental noise the sound pressure level, SPL, in decibels is calculated from:

$$\text{SPL} = 10 \log_{10} (p/p_0)^2 \quad [\text{dB}]$$

Where  $p$  is the sound pressure being measured and  $p_0$  is the reference sound pressure ;( 20 MPa)[4].

Equivalent continuous sound level ( $L_{eq}$ ) is defined as the steady sound pressure level that has the same total energy as the actual fluctuating noise over a given period of time, which is in fact the RMS sound level with the measurement duration used as the averaging time. Sound Exposure Level (SEL) is defined as that constant sound level which has the same amount of energy in one second as the original noise event. Therefore, SEL is similar to  $L_{eq}$  in that the total sound energy is integrated over the measurement period, but instead of then averaging it over the measurement period, reference duration of 1s [5].

There are various sources of noise that can affect the community. Namely, noise comes from industry, transportation, construction noise and from domestic and leisure activities. Transportation noise is the main source of environmental noise including road traffic, rail traffic and air traffic. Road traffic noise is a combination of noise resulting from the vehicle's engine noise and noise due to the interaction between the tyres of the vehicle and the road surface[6]. In 2006, an investigation study found that there is a variation in noise levels within different types of tyre (between 6 and 8 dB within certain tyre) in the EU[7].

Many researchers have studied and evaluate the noise pollution internationally and nationally. For example, Romania [8, 9],Greece [10], Sweden [11], United Kingdom[12] and brazil [13]. In countries with social problems such as Iraq, urban noise has not been receiving enough attention. However, there are some researchers have shown the problem of environmental noise such as in Jordon [14], Egypt[15] , Saudi Arabia[16], and in Iraq such as Baghdad [17, 18], Mosul [19], and Sulaimani [20]. There are several national and international guidelines relating to the acoustics of classrooms and hospitals, and because of the differences in lifestyle, climate (outdoor activities, open or closed windows) and building design make international agreements of noise limits impossible.

The aim of this work is to evaluate the noise level in some selected area in Al-Diwaniyah City and how it is compliance with the international guidelines.

## **2. Methodology:**

The noise pollution could affect many different places (schools, hospitals, health centres) in different time during the year, however, in this study; only five schools and five health centres in the city of Al-Diwaniyah, Iraq, were chosen to measure the noise around these buildings. Although there are few schools and health centres existed in quite area, however, the majority of buildings (Schools and health centres) are existed on the main roads and therefore the selected schools and health centres were located on tow –way direction road. Figure (1) shows the map of the selected places where the noise level were measured. The time for each measurement was 15 minutes and each measurement consists of 30 readings (every 30 seconds), the measurements were repeated for five days (during the working days). Therefore, it is about 150 readings, in total, were measured in different schools and health centres. Noise parameters were recorded in every measurement in dBA were: equivalent level ( $L_{eq}$ ), Peak noise level ( $L_{pk}$ ), maximum noise level ( $L_{max}$ ) and minimum noise level ( $L_{min}$ ).

During the measurement's days there was no rain or significant winds. Measurements were undertaken between (8:30am and 11:30am) during working days. Noise measurements commenced in morning with the start working hours in front of the school and health centres. Wherever possible, the sound level meter was placed more than (1m) away from the nearest classroom or the window of the health centre wall, to avoid the impact of reflected sound. The height of the sound level meter was (1.6 m). Due to the logistic issues; it was difficult to record the sound level in the hospitals and health centres at night and for long periods. Readings were achieved during the actual operating hours of the school and health centres.

The measurement was performed using sound level meters (SVAN 959), Poland as shown in figure (2). The device of (338\*82\*42 mm) in dimension, The SVAN 955 is all digital, and its weight about 630 gm including, microphone, preamplifier and tripods. The device can be used at a different climate condition in terms of temperature which from 10-50 C° and humidity up to 90%. The Total Dynamic Range: 15 dBA RMS to 141 dBA Peak as a measurement range. The sound level meters operated in fast mode using the A weighting filter.

Data were tabulated and analysed using simple descriptive statistics. Independent (unpaired) T- test for two means and analysis of variance for multiple means were used.  $P \leq 0.05$  were considered significant throughout data analysis.

## **3. Results and Discussion**

The results will present the noise around selected schools, and the noise around selected hospitals and health centres.

### **3.1- Noise at Schools**

The average values of the equivalent level of the traffic noise pollution in the selected schools for the five days (during the working days (Sunday - Thursday)) were tabulated in the table (1). Table (2) shows the minimum, maximum, and peak values of the sound level. It is important to mention that during the sport classes and pupils breaks; there was no measuring for the sound level meter. From the average values of the equivalent level for all the selected schools, it can be seen that the average values (about 65dBA) were exceeded the international a standards, since the WHO

guideline recommends that the noise level in the school playgrounds should not exceed 55dBA and 35dBA during the teaching sessions[6]. While the American national standards recommend about 35dBA in the classroom [21]. It is also noted that the average equivalent of these selected schools were exceeded the European legislation standards (average of 35dBA)[2], as shown in figure (3). Unfortunately there is no Iraqi guideline for the noise level in common places such as schools and hospitals.

The statistical analysis of the data show that there is a significant difference in the mean equivalent value only between Damascus with Dar Al-Salam school and between Damascus and Al-Markaziyah schools due to the fact that the classroom are slightly far from the main road (in Damascus school about 20m) and also due the face the Dar Al-Salam school location is surrounded by many different governmental authorities. In addition to that Al- Markaziyah School is very close to the commercial zone within the City and therefore different cars and trimotor cycles are passing close to the school. However, there is no significant difference between the mean averages of all the minimum values among the schools, which mean that all the school have been exposed to the same level of noise (same baseline of noise).the results were in compliance with other study carried out in Baghdad [17]. In noisy environments, children have poor school performance leading to stress and misbehaviour [22]. They also have decreased learning, and concentration deficits [23]. Therefore more attention should be paid to eliminate this issue.

### **3.2- Noise at Health centers**

The mean values of the equivalent level due to the traffic noise pollution in the selected hospitals and health centres for the five days (during the working days were tabulated in the table (3). The table (4) shows the minimum, maximum, and peak values of the sound level. From the average values of the equivalent level for all the selected health centres and hospitals, it can be seen that the average values (about 66 dBA) were exceeded the international a standards, since the WHO guideline recommends that the noise level in the hospitals should not exceed 35dBA. While the United States Environmental protection Agency (USEPA) recommend about 40dBA in the hospitals [24]. It is also noted that the average equivalent of these selected places were exceeded the UK legislation standards (30dBA) as shown in figure (4). There is no Iraqi guideline for the noise level in the health centres and hospitals.

The statistical analysis of the data shows that there is no significant difference in the mean equivalent value among the selected hospitals and health centres.

In addition, there is no significant difference between the mean averages of all the minimum values among the selected health centres, this mean that all the selected places have been exposed to the same background level of noise. It is interesting to note that the measurements on Tuesday were higher the rest of the working days significantly in the all selected places. The results were in accordance with another study that measuring the noise level in the main roads and streets that some of these selected schools and health centres exist on them. The results of this study were in compliance with the other studies achieved in other cities in Iraq, since it was in compliance with that one in Sulaimani [20]. However, it was lower that what they found in Mosul [19] and that might be due the differences in population, cars type and account and also in the locations of the selected places.

Several adverse effects linked with exposure to environmental noise. These can range from hearing loss to sleep disturbance to annoyance and even cardiovascular disorders.

The most predominant community response in a population exposed to environmental noise is annoyance. Noise annoyance can result from noise interfering with daily activities, feelings, thoughts, sleep, or rest, and might be accompanied by negative responses, such as anger, displeasure[11]. The most significant effects of environmental noise on health come in the form of annoyance and sleep disturbance.

### **3. Conclusions and Recommendations**

The study includes five schools and five health centres were having selected to evaluate the sound pressure level in Al-Diwaniyah City. The results obtained show that the schools that were exposed to high level of noise (about 65 dBA) when it compared with the international standards, where the minimum sound pressure levels were also exceeds the limits of WHO, USEPA, and United Kingdom Standards.

The statistical analysis of the results shows that there was significant difference between some schools due to either their location that surrounded by governmental or commercial area or because of the distance of the classroom to the main road. In terms of minimum sound level, there was no significant difference between selected schools and that reflect the same level of noise background that these schools are exposed.

All the noise level around the hospitals and health centres (66dBA) exceeded the international standards. Therefore, these results will be of help to planners and policy makers

in the City to combat such this problem. Consequently there some recommendations should be considered are:

- 1- Take the necessary actions to reduce the impact of noise on the buildings like providing dense trees as a sound barrier, in addition to consider the types of walls, floors and ceilings, windows and doors that provide better damping to the external noise as an acoustic insulation technique.
- 2- Undertake another study to assess the rest of the other authorities like police stations, universities, and some roads, intersection and roundabouts to draw a pic picture of the noise distribution around the city and find the solution to solve this issue especially with the traffic noise.
- 3- The development of environmental awareness and the creation of basic environmental knowledge in order to develop a positive environmental behaviour as a basic requirement that the citizen can effectively play its role in protecting the environment, thus contributing to the preservation of public health.
- 4- Legislate the Noise level standards for the common building and places by monitoring the sound level and establishing the suitable environment for each facility taking in the account the effect of places, type of authority, Type of noise, weather and the construction of these building in order to generalize that to be as a baseline to start with for buildings in the future.
- 5- A combination of strategies that include noise barriers, lower vehicle noise levels and better urban planning should be applied in order to reduce the noise pollution.
- 6- There is a need to study the noise level especially around hospitals in the night to see the pattern difference in sound level between day and night.

### **4. Acknowledgements**

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**Table (1):** Mean equivalent noise levels ( $L_{eq}$ ) in the selected schools in dBA with standard deviation.

| Schools<br>Day | Dar Al-Salam School | Damascus School | Al-Nahrain School | Al-Markaziyah School | Al-Quds School |
|----------------|---------------------|-----------------|-------------------|----------------------|----------------|
|                | $L_{eq}$ (dBA)      | $L_{eq}$ (dBA)  | $L_{eq}$ (dBA)    | $L_{eq}$ (dBA)       | $L_{eq}$ (dBA) |
| Sunday         | 66.0                | 60.2            | 63.7              | 67.1                 | 62.8           |
| Monday         | 69.6                | 60.7            | 72.9              | 75.4                 | 63.0           |
| Tuesday        | 64.1                | 60.0            | 66.0              | 69.1                 | 69.0           |
| Wednesday      | 68.7                | 60.3            | 59.8              | 69.8                 | 61.7           |
| Thursday       | 64.6                | 63.9            | 58.8              | 65.5                 | 61.5           |
| Average        | 66.6                | 61.0            | 64.2              | 69.4                 | 63.6           |
| STD            | 2.5                 | 1.7             | 5.7               | 3.8                  | 3.1            |

**Table (2):** The mean minimum ( $L_{min}$ ), maximum ( $L_{max}$ ), and peak ( $L_{Pk}$ ) noise levels for selected schools in dBA.

| Schools<br>Day | Dar Al-Salam School |           |           | Damascus School |           |           | Al-Nahrain School |           |           | Al-Markaziyah School |           |           | Al-Quds School |           |           |
|----------------|---------------------|-----------|-----------|-----------------|-----------|-----------|-------------------|-----------|-----------|----------------------|-----------|-----------|----------------|-----------|-----------|
|                | $L_{Min}$           | $L_{nax}$ | $L_{Pk}$  | $L_{Min}$       | $L_{nax}$ | $L_{Pk}$  | $L_{Min}$         | $L_{nax}$ | $L_{Pk}$  | $L_{Min}$            | $L_{nax}$ | $L_{Pk}$  | $L_{Min}$      | $L_{nax}$ | $L_{Pk}$  |
|                | (dB<br>A)           | (dB<br>A) | (dB<br>A) | (dB<br>A)       | (dB<br>A) | (dB<br>A) | (dB<br>A)         | (dB<br>A) | (dB<br>A) | (dB<br>A)            | (dB<br>A) | (dB<br>A) | (dB<br>A)      | (dB<br>A) | (dB<br>A) |
| Sunday         | 60.8                | 75.1      | 88        | 54.6            | 67.4      | 82.8      | 56.8              | 72.4      | 84.2      | 57.4                 | 71.8      | 85        | 58             | 67.4      | 79.7      |
| Monday         | 62.6                | 75        | 87.9      | 57.1            | 66.9      | 79.7      | 61.1              | 76.4      | 89.8      | 59.8                 | 71.2      | 84.4      | 58.8           | 71.2      | 85.8      |
| Tuesday        | 59.5                | 71.7      | 85.3      | 55.1            | 68        | 83.8      | 57.3              | 75.7      | 89.7      | 62.5                 | 78        | 91.1      | 62             | 78.6      | 91.6      |

|                  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |
|------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>Wednesday</b> | <b>62.4</b> | <b>77.9</b> | <b>90</b>   | <b>56.6</b> | <b>67.3</b> | <b>82.2</b> | <b>54.2</b> | <b>67.9</b> | <b>82.4</b> | <b>63.7</b> | <b>78.2</b> | <b>90.6</b> | <b>57.9</b> | <b>69.4</b> | <b>83</b>   |
| <b>Thursday</b>  | <b>58.5</b> | <b>72.2</b> | <b>86.5</b> | <b>60.4</b> | <b>71.6</b> | <b>85.8</b> | <b>52.4</b> | <b>68.7</b> | <b>82.2</b> | <b>60.2</b> | <b>73.2</b> | <b>86</b>   | <b>58.1</b> | <b>67.7</b> | <b>81.4</b> |
| <b>Average</b>   | <b>60.8</b> | <b>74.4</b> | <b>87.6</b> | <b>56.8</b> | <b>68.2</b> | <b>82.9</b> | <b>56.4</b> | <b>72.2</b> | <b>85.7</b> | <b>60.7</b> | <b>74.5</b> | <b>87.4</b> | <b>59</b>   | <b>70.9</b> | <b>84.3</b> |
| <b>STD</b>       | <b>1.8</b>  | <b>2.5</b>  | <b>1.8</b>  | <b>2.2</b>  | <b>1.9</b>  | <b>2.3</b>  | <b>3.8</b>  | <b>3.9</b>  | <b>3.3</b>  | <b>3.2</b>  | <b>3.4</b>  | <b>2.5</b>  | <b>4.7</b>  | <b>4.6</b>  | <b>1.7</b>  |

**Table (3):** Mean equivalent noise levels ( $L_{eq}$ ) in the selected hospitals in dBA with standard deviation.

| <b>Hospitals</b> | <b>Al-Jazaar Health Center</b> | <b>Al-Jamhoori Health Center</b> | <b>Special Center for Dentistry</b> | <b>Maternity and Child Hospital</b> | <b>Emergency ward of Al-Diwaniya Hospital</b> |
|------------------|--------------------------------|----------------------------------|-------------------------------------|-------------------------------------|---|
| <b>Day</b>       | $L_{eq}$ (dBA)                 | $L_{eq}$ (dBA)                   | $L_{eq}$ (dBA)                      | $L_{eq}$ (dBA)                      | $L_{eq}$ (dBA)                                |
| <b>Sunday</b>    | <b>54.7</b>                    | <b>67.1</b>                      | <b>57.9</b>                         | <b>62.3</b>                         | <b>59.9</b>                                   |
| <b>Monday</b>    | <b>58.3</b>                    | <b>61.2</b>                      | <b>61.5</b>                         | <b>68.2</b>                         | <b>62.3</b>                                   |
| <b>Tuesday</b>   | <b>72.6</b>                    | <b>70.4</b>                      | <b>73.7</b>                         | <b>70.1</b>                         | <b>72.5</b>                                   |
| <b>Wednesday</b> | <b>62.2</b>                    | <b>67.7</b>                      | <b>68.8</b>                         | <b>69.6</b>                         | <b>68.3</b>                                   |
| <b>Thursday</b>  | <b>59.1</b>                    | <b>68.9</b>                      | <b>63.2</b>                         | <b>60.7</b>                         | <b>59.4</b>                                   |
| <b>Average</b>   | <b>61.4</b>                    | <b>67.1</b>                      | <b>65.0</b>                         | <b>66.2</b>                         | <b>64.5</b>                                   |
| <b>STD</b>       | <b>6.8</b>                     | <b>3.5</b>                       | <b>6.2</b>                          | <b>4.4</b>                          | <b>5.7</b>                                    |

**Table (4):** The mean minimum ( $L_{min}$ ), maximum ( $L_{max}$ ), and peak ( $L_{Pk}$ ) noise levels for the selected hospitals in dBA.

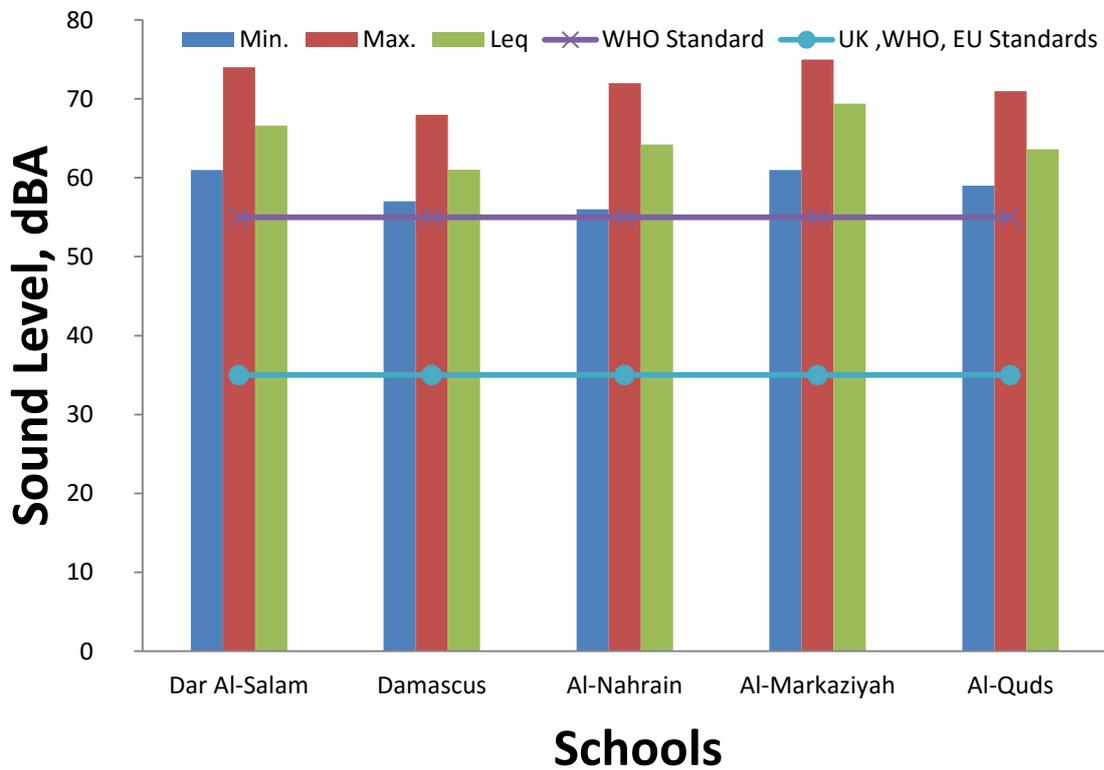
| Hospitals<br>Day | Al-Jazaar Health Center |                        |                       | Al-Jamhoori Health Center |                        |                       | Special Center for Dentistry |                        |                       | Maternity and Child Hospital |                        |                       | Emergency ward of Al-Diwaniya Hospital |                        |                       |
|------------------|-------------------------|------------------------|-----------------------|---------------------------|------------------------|-----------------------|------------------------------|------------------------|-----------------------|------------------------------|------------------------|-----------------------|--|------------------------|-----------------------|
|                  | $L_{Min}$<br>(dB<br>A)  | $L_{nax}$<br>(dB<br>A) | $L_{Pk}$<br>(dB<br>A) | $L_{Min}$<br>(dB<br>A)    | $L_{nax}$<br>(dB<br>A) | $L_{Pk}$<br>(dB<br>A) | $L_{Min}$<br>(dB<br>A)       | $L_{nax}$<br>(dB<br>A) | $L_{Pk}$<br>(dB<br>A) | $L_{Min}$<br>(dB<br>A)       | $L_{nax}$<br>(dB<br>A) | $L_{Pk}$<br>(dB<br>A) | $L_{Min}$<br>(dB<br>A)                 | $L_{nax}$<br>(dB<br>A) | $L_{Pk}$<br>(dB<br>A) |
| Sunday           | 47.9                    | 65.8                   | 90.5                  | 65.6                      | 71.5                   | 94.2                  | 53.6                         | 71.9                   | 88.8                  | 56.7                         | 73.3                   | 91.4                  | 55.4                                   | 70.1                   | 88.6                  |
| Monday           | 55.8                    | 65.6                   | 85.5                  | 58.9                      | 77.2                   | 90.8                  | 57.4                         | 69.6                   | 92.2                  | 65.9                         | 75.5                   | 91.7                  | 59.5                                   | 71.5                   | 90.9                  |
| Tuesday          | 66.5                    | 108.3                  | 123.6                 | 64.6                      | 95                     | 105.7                 | 65                           | 90.7                   | 103.2                 | 62.2                         | 89.6                   | 104.7                 | 66.2                                   | 86.9                   | 98.1                  |
| Wednesday        | 55.5                    | 78.5                   | 101                   | 61                        | 87.8                   | 102.2                 | 59.7                         | 92.4                   | 104.9                 | 58.7                         | 88.5                   | 100.6                 | 60.4                                   | 85.5                   | 98.8                  |
| Thursday         | 57.8                    | 67.6                   | 84.5                  | 63.6                      | 88.9                   | 104.3                 | 59.4                         | 70.9                   | 91.2                  | 56.9                         | 70.8                   | 92.7                  | 57.4                                   | 68.3                   | 88.6                  |
| Average          | 56.7                    | 77.2                   | 97                    | 62.7                      | 84.1                   | 99.4                  | 59                           | 79.1                   | 96.1                  | 60.1                         | 79.5                   | 96.2                  | 59.8                                   | 76.5                   | 93                    |
| STD              | 16.2                    | 18.2                   | 6.7                   | 6.6                       | 9.5                    | 2.7                   | 7.4                          | 11.4                   | 4.1                   | 6.1                          | 8.8                    | 3.9                   | 5.1                                    | 9.0                    | 4.1                   |



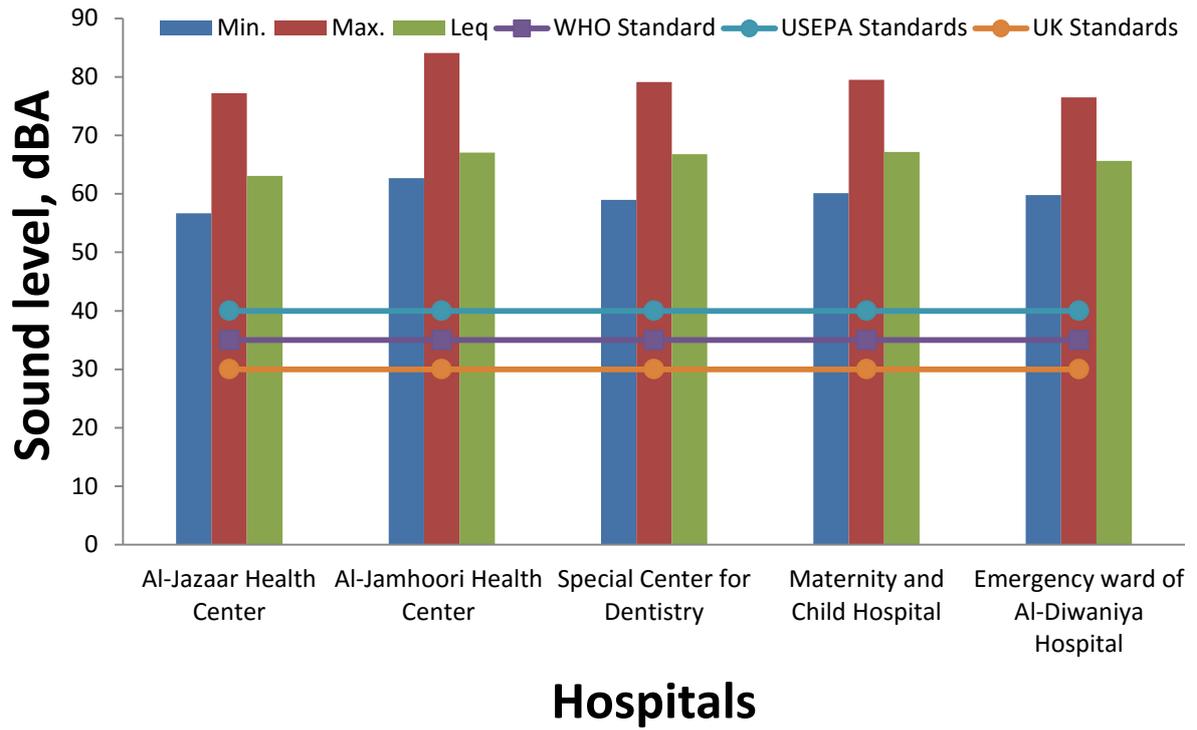
**Figure (1):** Map of the Al-Diwaniyah City with the selected places (Google earth)



**Figure (2):** SVAN Sound Level Meter.



**Figure (3):** Mean equivalent, Minimum and maximum level with the international standards for selected schools.



**Figure (4):** Mean equivalent, Minimum and maximum level with the international standards for selected health centres.